2nd Draft.

Little Grand Lake Wood Harvesting Operation

Environmental Impact Statement

Corner Brook Pulp and Paper Limited

LITTLE GRAND LAKE
WOOD HARVESTING OPERATION
ENVIRONMENTAL IMPACT STATEMENT

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EXECUTIVE SUMMARY

INTRODUCTION

Corner Brook Pulp and Paper Limited (CBPPL), owned by Kruger Incorporated of Montreal, proposes to carry out long term timber harvesting and forest management on its timber limits in the Grand Lake — Little Grand Lake area as part of an integrated wood procurement program for its newsprint mill at Corner Brook. The total annual allowable cut from all company limits is calculated to be 1,109,400 m^3. This closely matches the projected annual consumption of 1,150,000 m^3 for the mill by 1991. Because there are no alternate sources of wood on the island or in Labrador, the acquisition of wood from all of the company's limits (including the Grand Lake—Little Grand Lake limits) on the island is essential if the Corner Brook operation is to continue.

This Environmental Impact Statement (EIS) is prepared in accordance with the guidelines issued by the Department of Environment and Lands of Newfoundland and Labrador. The company, the public and government departments identified three valued ecosystem components (pine marten, historic resources, steep terrain) which must be assessed for environmental impact. Original research programs were carried out for these components. Other environmental elements, which were not deemed to be valued ecosystem components, were evaluated from existing information and from interviews with knowledgeable individuals.

PROPOSEDUNDERTAKING

The company proposes to harvest approximately 48% of the productive forest (28% of the total land base) within the 35,000 ha study area on a sustained yield management basis over the next 20 - 30 years at a rate of up to 65,000 m^3 per year. Approximately 1% of the total area will be harvested each year using a combination of cut and skid as well as cut and bunch operations. The clearcuts resulting from the harvesting operations will vary in size and be irregular in shape as dictated by terrain conditions and patterns of forest cover. Slopes exceeding 45% will not be harvested.

From 80 to 100 woods and construction workers will find employment in timber harvesting, providing silviculture treatment, and in constructing the approximately 50 km of roads required by the project. All workers will be bussed daily to the job.

ENVIRONMENT SETTING

A general synopsis will be provided of the existing environment before examining the three valued ecosystem components in more detail.

The study area is heavily forested and has a very rugged topography with the surficial geology dominated by bedrock and by deposits of glacial origin. Although a number of mineral occurrences are known for the study area, none appear to hold promise for development.

The fisheries resource of the study area is quite modest. The small quantities of dissolved materials and the poor shoreline development of both Grand and Little Grand Lakes result in very limited productive capacity for salmonoid species (ouananiche, brook trout) in these waters.

The wildlife resource is more diversified. Eight species of waterfowl have been reported to breed in the study area, with Canada goose and common goldeneye being the most common, but even for these species numbers are not high. The study area lies within the Long Range Barrens ecoregion, one of the most unproductive habitats for waterfowl in Newfoundland. For raptors, however, the study area's escarpments, mature forest and barrens (with water bodies present), represents favourable habitat. Seven species of raptors, including bald eagle and osprey, have been observed there. Most of these seven species likely breed within the study area although no nests were observed there during this study.

Four species of upland game (including snowshoe hare, ptarmigan, and ruffed grouse) are found in the study area. Numbers are low because these species prefer habitat which provides the early successional stages of vegetation such as occurs after fire or logging. Six species of furbearers are found in the study area, with red fox and lynx being the most frequently observed. Both major big game species (moose and caribou) are present in the study area, but in low numbers. Some moose overwinter in stands of mature forest, but generally find much of the area unsuitable as summer habitat. Limited numbers of caribou pass through the area during spring and fall migrations, but very few occupy the study area year round.

Steep Terrain

The land systems of the entire study area were mapped using 1:50,000 scale aerial photographs. All areas deemed to be potentially sensitive (based on slope, drainage and vegetation) to logging and road construction were delineated. These potentially sensitive areas were then examined using more detailed (1:15,840 scale) aerial photographs; eight areas retained their potentially sensitive status. Of these eight areas, only two are proposed for harvesting. And field checking, plus comparison with similar terrain previously logged outside the study area indicated that negative impact at these sites was unlikely if buffer zones of vegetation are left around the more sensitive parts. Soils of the study area are generally stable, and not easily eroded.

Historic Resources

Aerial and ground surveys were carried out to determine if sites of archaeological significance were present in the study area. Four low rock mounds were discovered on the south side of Little Grand Lake. These mounds were considered to be of recent origin. No evidence of use by aboriginal peoples was found, and no further archaeological research is recommended.

Pine Marten

The potential impact that the proposed development may have on the threatened Newfoundland pine marten is the single major concern in this environmental assessment. On the island of Newfoundland marten were once found in most forested areas, although probably never in great numbers. By the early 1900's marten populations had begun to decline. The evidence suggests that the initial decline was likely caused by overtrapping, with habitat destruction by forest fire becoming a contributing factor soon afterward. The harvesting of sawlogs caused habitat alteration unfavourable to marten in the early 1900's, but the scale of these operations was such that the influence of sawlog harvests on marten populations and habitat would have been minor. Logging for pulpwood began to cause alteration of the mature forest habitat only after the marten population had been in serious decline for some time. And finally, disease may have been a contributing factor to the initial decline.

A major objective of this particular environmental assessment, therefore, is to assess the potential impact of forest harvesting operations on pine marten. CBPPL financed a 2-year study of marten at Little Grand Lake. This study, carried out by graduate students from Utah State University, monitored the behaviour of radio-collared marten before, during and after an experimental logging program. The study also presented a comprehensive review of the literature of marten — logging interactions.

A disease that swept through the marten population during the study unfortunately caused the death of many of the collared animals. Evidence obtained from the remaining study marten indicated that while marten avoid clearcuts much of the time, the animals are unlikely to abandon the study area. Of the three radio collared animals that provided location signals throughout the study, one showed a 25% reduction in home range, one exhibited essentially no change, and the third increased its home range by 100% (the expansion was mostly logged area) during the period of study. The complete report on the 2-year marten study is provided as a separately bound companion volume to this EIS.

PUBLIC PARTICIPATION

Two public information sessions to describe the harvesting and management operations proposed for Little Grand Lake were held in Corner Brook on December 3, 1988. Although announced repeatedly in all media for a period of three weeks in advance, the meetings were not well attended. A total of 25 - 30 people attended the two sessions, with about half of the individuals representing the media, the company, and the provincial government.

POTENTIAL IMPACTS

The pine marten is the valued ecosystem component most likely to experience negative impact as a result of the proposed development. The alteration and removal of portions of the mature conifer forest preferred by marten will probably result in generally lower population levels in the study area.

Based on density and productivity figures generated during the 2-year marten study, the logging operation may result in up to ten fewer young marten being born in the study area each year than at present.

However, a reduced number of marten in the study area is not expected to negatively affect the regional population to a significant degree. The study area lies at the approximate centre of a much larger area identified as high density marten habitat by the Newfoundland Wildlife Division. Kit production at Little Grand Lake represents only about 10% of the kits produced in the entire high density area.

In actual fact, habitat disturbance and kit production at Little Grand Lake itself may not be significantly negative. Approximately half of the forest stands will remain unharvested, and substantial buffer zones and travel corridors will be left uncut to provide general access to all areas for marten and other wildlife. In addition, the food base for marten will unquestionably improve in response to the early successional stages of vegetation which will invade the cutovers. This will have a positive effect on marten success.

Thus, while it can be concluded that timber harvesting at Little Grand Lake will have a negative impact on marten, the evidence suggests that the impact is unlikely to be significant.

No other component of the Little Grand Lake environment is expected to be negatively affected by the proposed development if the suggested mitigative measures are followed.

Social and economic impacts resulting from the proposed development will be positive. Eighty to one hundred workers will be employed on the project for the long term. The annual woods payroll from the Little Grand Lake operation will be approximately $2,000,000, with the total economic activity generated by the project reaching $14,000,000peryear.

MITIGATION/MONITORING

A number of conventional mitigation measures related to road building and stream crossing techniques, and the provision of buffer zones along watercourses are proposed to minimize the potential impact of the development on particular elements of the aquatic and terrestrial environment. The major new mitigation measure, however, is the commitment by CBPPL to leave in excess of 200 km^2 of land undeveloped: a 100 km^2 block (encompassing most of Little Grand Lake) in the southern part of the study area, two major east-west migration corridors (total of approximately 10 km^2) in the northern part (the uncut areas between targeted harvest blocks represent another substantial system of travel corridors extending throughout the study area), and approximately 100 km^2 of Company land on Glover Island. This commitment represents the Company's contribution to a pine marten reserve should the Province elect to create such a reserve in the area in the future.

In addition, CBPPL is willing to join the Wildlife Division in examining other courses of action (over and above the mitigative measures) that could benefit marten. Such action could include an assessment of the feasibility of (1) introducing a small mammal food species (red backed vole) to the Little Grand Lake area, and (2) a breeding program to provide marten for release in the wild. The Company believes that Glover Island, because of its isolation, could serve as the location for either or both of these purposes.

CBPPL will be undertaking monitoring programs relating to the forestry resource of the study area (including monitoring the revegetation of steep slopes) and will cooperate with government departments which may wish to undertake other monitoring projects. The company also suggests that it meet with the Department of Environment and Lands on a regular basis (at least once a year) to discuss the ongoing timber harvesting project at Little Grand Lake.

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1.0 INTRODUCTION

Corner Brook Pulp and Paper Limited (CBPPL) proposes to carry out long term timber harvesting and forest management on its timber limits in the Grand Lake — Little Grand Lake area as part of an integrated wood procurement program for its newsprint mill at Corner Brook. Harvesting will take place on approximately 33% of the land base (representing approximately 58% of the productive forests within the study area), with approximately 1% of the land being disturbed each year. In 1986 CBPPL began harvesting 241,000 m^3 of wood in designated areas under an exemption granted by the provincial government, in part to accommodate a research requirement for this study. The company proposes to begin regular harvesting operations in 1989, with the initial harvests to focus on the insect killed forests located in the north-east corner of Little Grand Lake.

Upon review of the registration under the *Environmental Assessment Act (1980)*, the Minister of Environment required that CBPPL prepare an environmental impact statement (EIS) for the proposed timber harvesting project. This EIS, prepared in accordance with guidelines issued by the Department of Environment, provides information on the timber harvesting and on the existing environment to facilitate an assessment of the environmental acceptability of the project. The potential impacts of the project on the existing environment are identified and mitigative measures are outlined. Residual impacts and environmental monitoring are also discussed.

The EIS focuses on three valued ecosystem components (Beanlands and Duinker, 1983) which have been identified by CBPPL, the public and government departments. These three components are pine marten, historic resources, and terrain sensitivity. Elements of the environment which have not been shown to be valued ecosystem components in this particular assessment are discussed only in sufficient detail to provide a clear understanding of their relationship to the project. This discussion is based on existing information and on the results of interviews with knowledgeable individuals.

Original work, involving both field surveys and office analysis, was carried out for each of the three component studies mentioned. The results of all three studies are incorporated into this EIS; the major component study (pine marten) will also be submitted as a separate report.

The Little Grand Lake study area is located in the west-central part of the island (Figure 1). The area requiring detailed study, Licenced Lot 127 and portions of Licenced Lot 38 and Reid Lot 225, encompasses Little Grand Lake and borders the south-eastern shore of Grand Lake (Figure 2). The area is heavily forested and the terrain is rugged.The Little Grand Lake area is considered by the Newfoundland Wildlife Division to be an important stronghold for the threatened Newfoundland pine marten (*Martes americana*). In 1973 the Government of Newfoundland and Labrador created a pine marten assessment area and directed that any development taking place within this area must be evaluated for impact to pine marten. As Figure 3 shows, the assessment area boundaries extend a considerable distance beyond the CBPPL holdings. While this EIS will deal only with impacts within the CBPPL holdings, it was found necessary occasionally to consider the broader regional perspective of particular resources.

1.1 Acknowledgements

We are grateful to have had the opportunity during this study to exchange ideas and information with many individuals. In particular, we wish to acknowledge the following:

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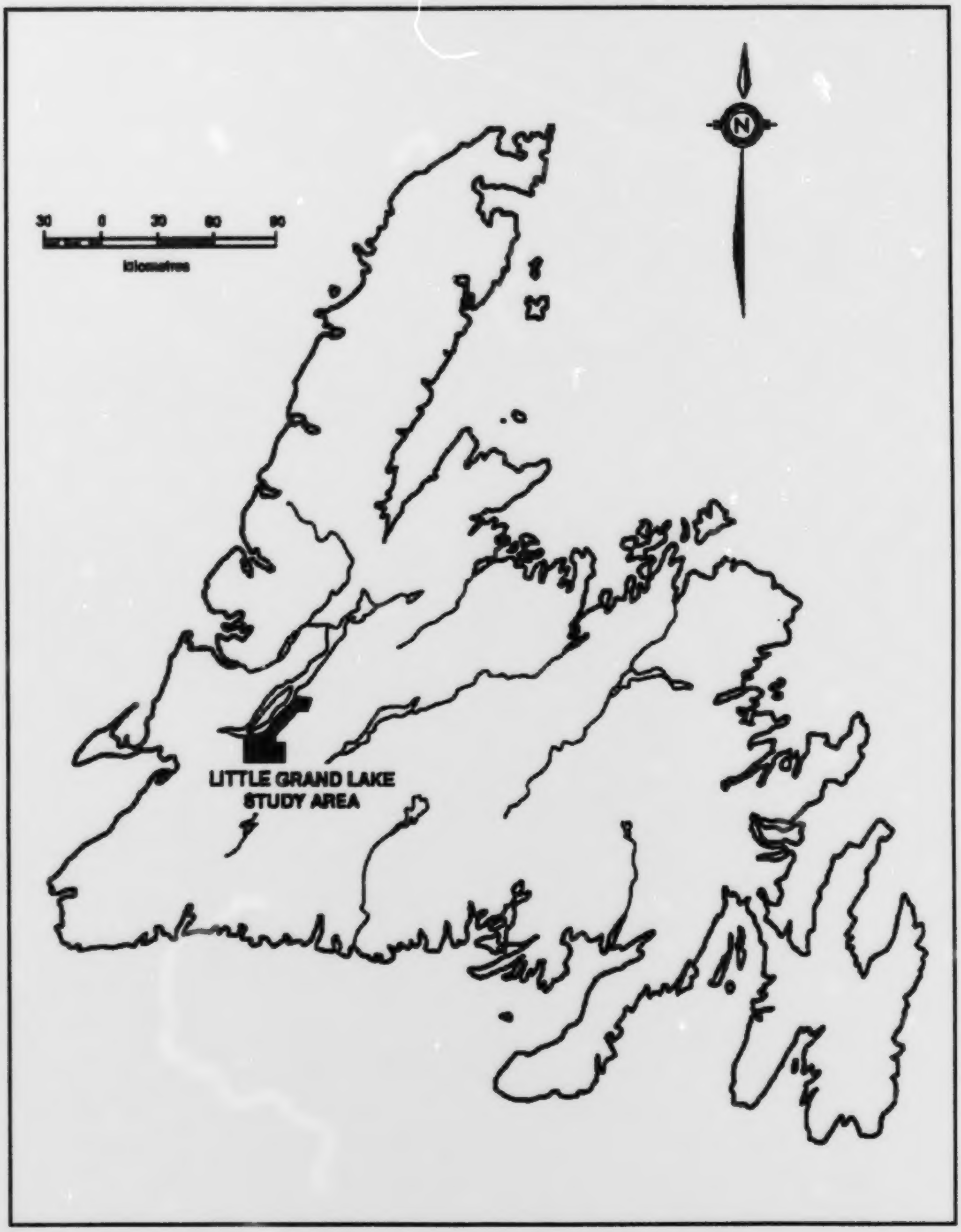
The Forest Management Division of the Department of Forestry provided the computer data from which the forest inventory information was compiled. The assistance of the Division is much appreciated.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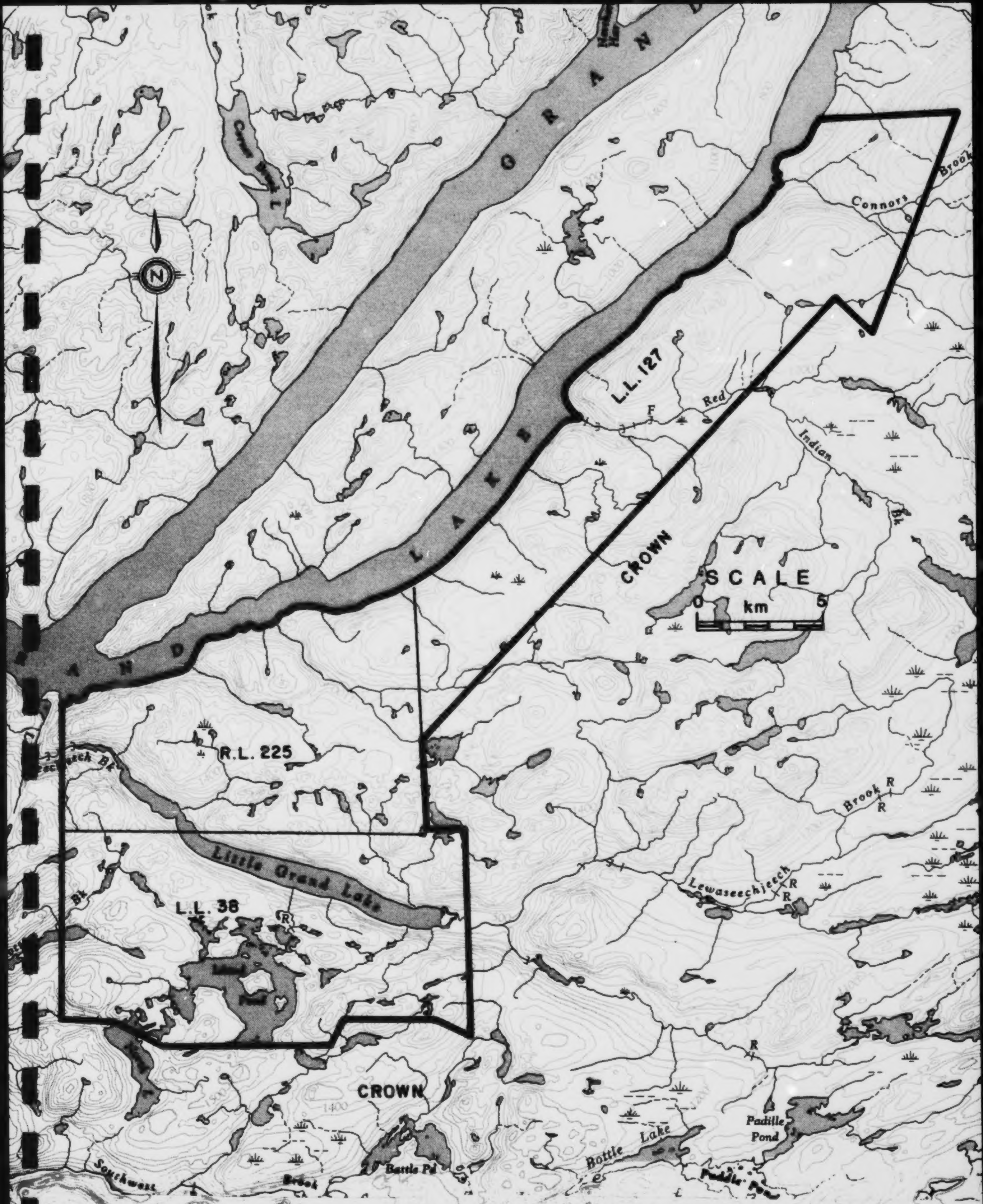
LITTLE GRAND LAKE
STUDY AREA

Figure 1

Location of Little Grand Lake study area

Figure 2

Little Grand Lake study area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F
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Brook
Indian
Bk
CROWN
SCALE
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Little Grand Lake
L.L. 38
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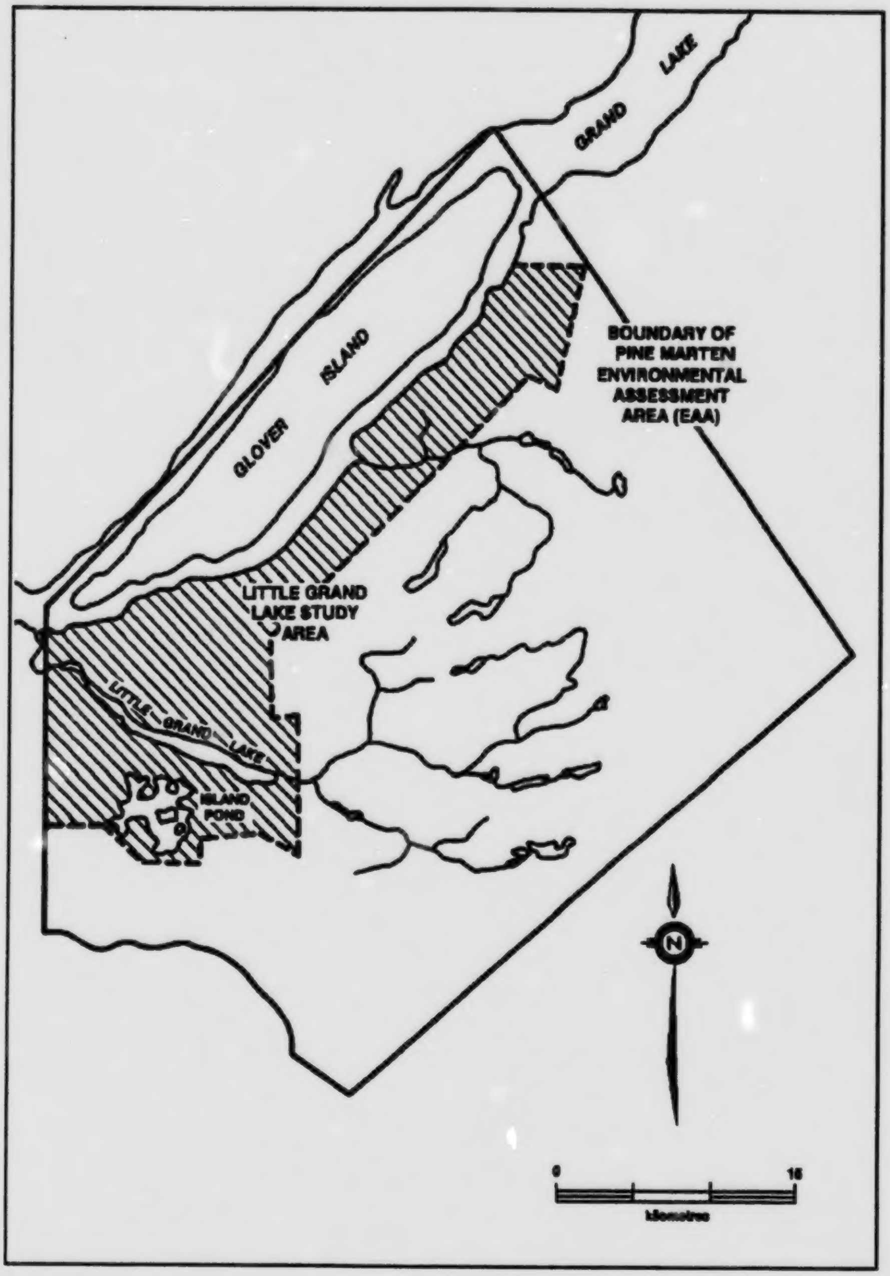

GRAND LAKE
GLOVER ISLAND
BOUNDARY OF PINE MARTEN ENVIRONMENTAL ASSESSMENT AREA (EAA)
LITTLE GRAND LAKE STUDY AREA
LITTLE GRAND LAKE
ISLAND POND
N
0
15
kilometres

Figure 3

Pine marten environmental assessment area

2.0 PROJECT DESCRIPTION

CBPPL proposes to harvest the merchantable timber in the Little Grand Lake area over the next 20-30 years. This harvest will be influenced by market conditions, insect and fire damage, and a number of other variables. Consequently, the proposed development cannot be described in detail (e.g. road construction schedule, cutting location etc.) prior to start-up. It is, of course, possible to provide a general description of the project, with details of short-term segments of the operation. Such information is provided in the remainder of this section.

2.1 PROPONENT AND NEED

Corner Brook Pulp and Paper Limited, owned by Kruger Inc. of Montreal, operates a newsprint mill at Corner Brook, Newfoundland. The raw material for this mill comes entirely from Company timber limits on the island of Newfoundland (Figure 4) The total annual allowable cut (AAC) available from Company limits is calculated to be 1,109,400 m^3 (Table 1). This figure, based on CBPPL inventory information, is contained in the Company's management plans, and has been reviewed and accepted by the Department of Forestry. This AAC closely matches the annual consumption of the mill for the past 10 years and the projected annual requirement for the next five years (Table 2). In view of the fact that there are no alternative sources of wood supply on the island, and that off-island wood is not economically feasible (alternative wood supplies are discussed in Section 2.3 of this of this report), the acquisition of wood from all of the Company's timber limits on the island is essential to the continuing viability of the Corner Brook operation.

CORNER BROOK PULP AND PAPER LIMITED

Calculated Annual Allowable Cut

M.U.	A.A.C.(m^3)	Distance from Mill (km)
15	221,000	50
14	76,300	125
16	192,000*	150
9	262,700	170
17	89,000	275
8	14,000	375
6	54,000	375
18	119,000	400
5	81,400	425
Total	1,109,400m^3	

Table 1

2.2 PROJECT DESCRIPTION

2.2.1 The Area

The Little Grand Lake study area contains all of Company License Lot 127 and portions of Company License Lot 38 and Reid Lot 225. The License lots are Provincial Crown land on which the Company owns the timber rights. These timber licenses expire in the year 2037. Reid Lot 225 is Company freehold land. Figure 2 shows lot boundaries.

The study area is approximately 35,000 ha in size. The topography is rugged with steep mountains rising from the water of Grand Lake to the northwest and Little Grand Lake to the southwest. Peak elevation in the study area reaches over 600 m above sea level. The forests are predominantly

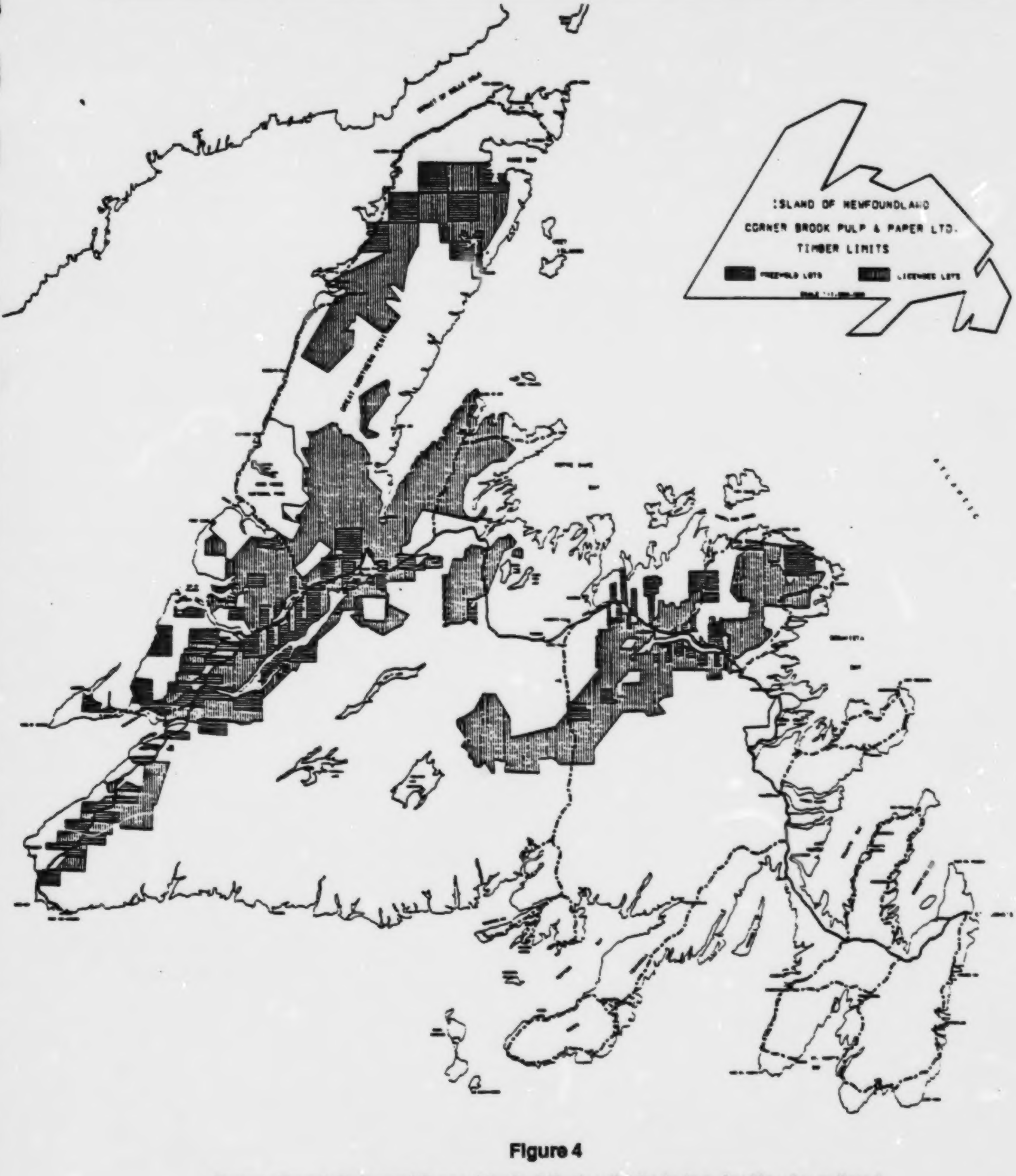

ISLAND OF NEWFOUNDLAND
CORNER BROOK PULP & PAPER LTD.
TIMBER LIMITS
FREEHOLD LOTS
LICENSED LOTS
ATLANTIC

Figure 4

Corner Brook Pulp and Paper Limited timber limits in insular Newfoundland

CORNER BROOK PULP AND PAPER LIMITED

Mill Wood Useage 1979 - 1988 and Projected Requirements 1989 - 1993

Year	Amount (m^3)
1979	1,082,619
1980	1,174,518
1981	1,120,981
1982	936,590
1983	450,517
1984	813,190
1985	828,924
1986	666,652
1987	789,935
1988	906,739
1989	918,222
1990	1,120,000
1991	1,150,000
1992	1,150,000
1993	1,150,000

Table 2

Area, by land class, of productive forest land in Little Grand Lake study area

Land class	Area (ha)
B (Bog)	1,957.2
F (Forest)	18,623.2
H (Hardwood Scrub)	52.5
R (Rock Barren)	1,149.4
S (Soil Barren)	2,977.7
T (Softwood Scrub)	8,663.9
W (Water)	1,789.8
Total	**35,213.7**

Table 3

PROPOSED FIVE YEAR HARVESTING PLAN LITTLE GRAND LAKE STUDY AREA

1990- 1994

Year	Volume m^3	Area ha	Capital Roads (km)	Bridges	Harvest Block Number
1990	20,580	236	8.0	1	16, 8, 15, 16
1991	44,098	369	6.4	—	8, 16, 17
1992	45,821	314	6.4	1	1, 3
1993	59,294	467	6.4	1	6, 9
1994	59,724	547	6.4	2	6
Total	**223,992**	**1,933**	**48.3**	**5**	

Table 4

balsam fir (*Abies balsamea*) with minor occurrences of black spruce (*Picea mariana*) and white birch (*Betula papyrifera*) throughout. Bogs, barrens and scrub forest are scattered throughout the area. Table 3 shows the area of various land classes within the study area.

Productive forests occupy 18,623.2 ha (53%) of the study area. Harvesting is proposed for 9,821.9 ha representing 27% of the total area and approximately 50% of the productive forest within the study area. The remaining 8,801.3 ha of productive forest is not proposed for harvest; 82% (7,172 ha) of this is mature and overmature softwood forest. The areas proposed for harvest are shown generally in Figure 5 and in detail on Map 1.

The Forest Resource

A detailed stand list of all stands proposed for harvest is shown in Appendix 1. The total softwood volume in the area is 2,117,544 m^3 of which 1,056,170 m^3 will be harvested. Forest inventory data are derived from the Provincial Forest Management Inventory compiled by the Forest Management Division of the Department of Forestry.

2.2.2 Proposed Management and Operation Plan

The management of the Little Grand Lake Study Area will be similar to that of other Company forest lands in western Newfoundland. The proposed management regime consists of a commercial clear cut removing all merchantable softwood trees in areas proposed for harvest followed by regeneration of cut-over areas to softwood species by natural or artificial means.

Harvesting

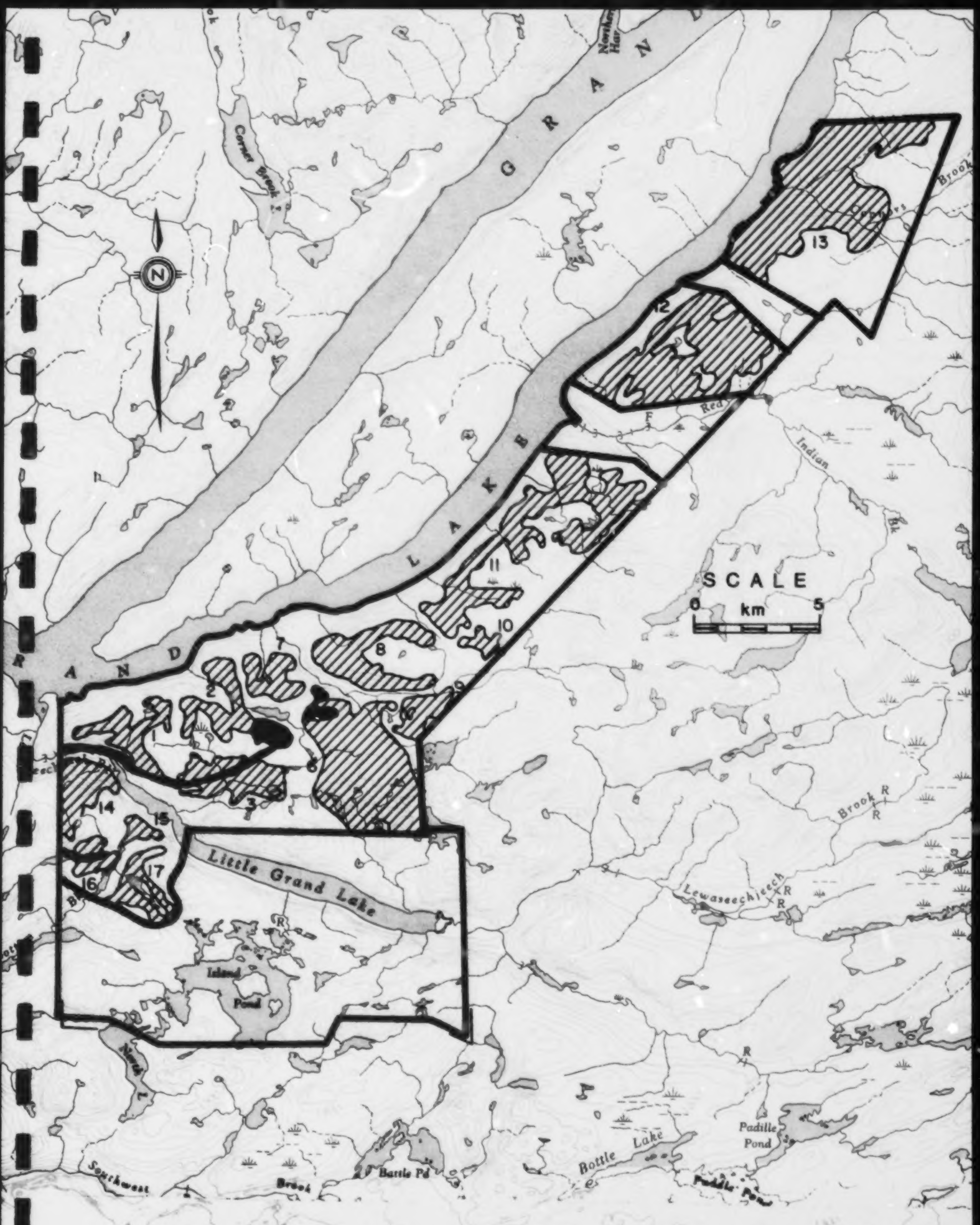
Corner Brook Pulp and Paper Ltd.'s forest management activities in the Little Grand Lake area will be part of the Company's sustained yield management of its timber limits in management units 14 and 15. The Company proposes to harvest the merchantable timber in the Little Grand Lake area over the next 20-30 years at a rate of up to 65,000 m^3 per year. Table 4 summarized the harvest plan for the next five years. This plan is shown in detail on forest inventory type maps (Maps 2A and 2B).

Using existing technology, harvesting will be carried out by a combination of cut and skid tree length operations and conventional cut and bunch operations. Cut and skid tree length operations consist of manually felling and de-limbing trees at the stump followed by skidding the tree length logs to roadside using cable skidders. At roadside, the tree length logs are slashed into 2.5 meter lengths and loaded on tractor trailers for delivery to the mill. This will be the most common logging method used in the study area. In low volume stands or stands with small average tree size, conventional cut and bunch operations will be employed. In this type of harvesting operation trees are manually

Figure 5

Areas proposed for timber harvest in Little Grand Lake study area

▨	Blocks targeted for harvesting
8	Block number
)	Area harvested in 1986


Northern Har
G R A N D L A K E
Corner Brook
N
Brook
13
12
Red
F
Indian
Bk
11
10
SCALE
0 km 5
8
7
9
2
1
6
3
14
15
16
17
Little Grand Lake
Island Pond
R
Brook
Lewaseechjeech
North L
Southwest Brook
Battle Pd
Bottle Lake
Padille Pond

felled, de-limbed and bucked into pulpwood lengths at the stump. The 2.5 meter logs are manually bunched into small piles which are picked up by a pulpwood forwarder and brought to roadside for loading onto tractor trailers. Wood will be delivered to the mill in 2.5 meter lengths on tractor trailers. A typical tractor trailer carries 40-45 m^3 per load.

The clear cuts resulting from the proposed harvesting operations will vary in size and will be irregular in shape as dictated by terrain conditions and patterns of forest cover. Forests on very steep slopes, and unmerchantable forests on any slope will not be harvested, thus creating uncut forested areas throughout.

Silviculture

Following logging, all cut-over areas will be assessed for regeneration status. Areas not regenerating naturally will be scheduled for reforestation. It is not anticipated that large scale planting will be required in the Little Grand Lake area. Cut-overs in areas adjacent to the study area have regenerated naturally to balsam fir and adequate natural regeneration is anticipated on cutovers within the study area. Therefore the most probable silvicultural regime for the area will be logging followed by natural regeneration to softwood species and a subsequent thinning treatment in selected stands at age 8-15 years.

Forest Protection

Protection of the forest from damage by wildfire and insect attack is an integral part of any forest management program. Under Newfoundland regulations the responsibility for fighting forest fires lies with the provincial Department of Forestry. Corner Brook Pulp and Paper maintains fire fighting equipment at all of its operations in accordance with provincial regulations and fights wild fires on its limits as required.

Insect control programs are carried out as needed. In the past few years, these programs have been carried out by the province and cost shared by the major timber owners on the island.

Manpower and Machinery

The manpower and machinery requirements for the 5-year (1990-1994) harvesting plan at Little Grand Lake are shown in Table 5.

Pits and Quarries

Road construction in the Little Grand Lake study area will generally be done using the material available from the right-of-way of the road. There may be some areas where suitable material is not available from the right-of-way; in such cases a section of road will have to be constructed using pit ballast. As well, some sections of road may require surface dressing with ballast. In these cases, quarry pits will be required. These will be identified as they are needed. All pits will be opened and operated under the *Quarry Materials Regulations, 1977.*

Camps, Buildings and Fuel Storage

No logging camps will be constructed in the study area. Should camp accommodations be required for Company employees in the area they will be provided in existing Company camps outside the study area.

Mobile garages will be used to maintain forest harvesting equipment during the operation of the project. These garages, mounted on large rubber tires, will be relocated periodically to follow the progress of the harvesting operations. Garages will be located on relatively level, well drained sites well away from water bodies and other sensitive areas.

There will be no permanent fuel storage facilities located within the study area. Fuels required for the day to day operations will be stored in mobile tanks constructed and located in accordance with the *Storage and Handling of Gasoline and Associated Products Regulations, 1982.*

Stream and River Crossings

The location of stream crossings during the first five years of operations are shown in the operating plan. All bridges will be of standard Company design. Bridges on major roads with a useful life of more than 3-5 years will be of concrete and steel construction. Roads with a life span of less than 3-5 years will have bridges of wood crib construction. All culvert installations will use corrugated steel culverts.

All standard Company bridge and culvert installations generally follow the recommendations contained in McCubbin *et al.* (1985). Individual stream crossings require the approval of the Provincial Department of Environment and Lands prior to installation.

MANPOWER/MACHINERY REQUIREMENTS 1990-1994

LITTLE GRAND LAKE STUDY AREA (5 YEAR HARVESTING PLAN)

CAPITAL ROADS

Year	km	Tractors	Excavators	Total Men
1990	8.0	1	1	3
1991	6.4	1	1	3
1992	6.4	1	1	3
1993	6.4	1	1	3
1994	6.4	1	1	3

HARVESTING

Year	(m^3)	Forwarders	Slashers	Tractors	Loaders	Trucks	Men
1990	20,000	7	1	2	1	3	35
1991	44,000	11	1	2	1	5	47
1992	45,000	11	1	2	1	5	50
1993	59,000	15	1	3	1	7	73
1994	59,000	15	1	3	1	7	73

Table 5

Permits

The following permits are required for the operation of this project:

1. Approval of annual operating plan by the Provincial Department of Forestry.

2. Permits from the Provincial Department of Mines and Energy for all borrow pits, and quarry permits if they are required.

3. Stream crossing permits from the Provincial Department of Environment and Lands and the Federal Department of Fisheries and Oceans for all stream and river crossings.

No fording or burning will take place during the operation, and no camp waste will be produced. Consequently, no permits will be requested for these activities.

2.3 ALTERNATIVE WOOD SUPPLIES

The proposed forest management and wood harvesting plan described previously was developed following an evaluation of alternate on-island and off-island wood supplies. A similar evaluation carried out for the Upper Humber — Main River area (Northland Associates, 1986) clearly showed that there is no surplus wood available on CBPPL limits. This situation has not changed; there is no surplus wood on Company limits to replace the wood at Little Grand Lake. Nor are there alternative sources of wood available from other lands on the island. Poole *et al.* (1981) concluded that there is likely to be a wood supply deficit on non-alienated Crown land beginning in the mid-1980s and continuing into the foreseeable future; by the year 2000 this deficit is estimated to be about 20%. Estimated future wood demands are compared with the annual allowable cut projections for non-alienated lands in Figure 6. The shortfall is obvious, particularly in the absence of a full forest protection program. The Department of Forestry and Agriculture has recently completed a timber supply/demand analysis for the island which has confirmed this forecast deficit. Wood supply/demand comparisons for the entire island and for CBPP timber limits are shown in Figures 6a and 6b. This analysis shows that there is a significant shortfall of sustainable timber supply for the island as a whole and that CBPPL limits can just support projected mill requirements (R. Mercer, per. comm.)

Off-island wood does not appear to be an economically feasible alternative. Poole *et al.* (1981) estimated that the cost of wood from Labrador delivered to the west coast of the island is more than twice as expensive as island wood. The high cost of Labrador wood was a major factor in Bowater's closure of its Port Hope Simpson harvesting operation in the late 1960s, and Labrador Linerboard's failure in the early 1970s. Even if costs were not prohibitive, the volume of available Labrador wood would make the area questionable as a source of supply. Poole *et al.* (1981) state that the volume of wood which Figure 6 could be brought in from Labrador is small, and would have a negligible impact on easing the overall wood shortage on the island.

2.4 Alternative Harvesting Scenarios

Given the age of the forest in the study area, the lack of developed access roads in the area and the considerable amount of insect damage to the forest in the study area, there are few, if any, realistic alternatives to the proposed harvest plan for utilizing the forest resources of the study area. More than 80% of the softwood forest in the area is mature and overmature. A significant amount of this forest has been damaged by the hemlock looper in recent years (Fig. 7). This overmature, damaged forest will be naturally replaced by a new young forest over the next 20-30 years. This is the natural ecology of the Canadian boreal forest. If the resource is not utilized over this period of time as proposed in CBPPL's harvest plan, the economic and social benefits of utilizing this resource will be lost for at least one complete natural rotation of the forest (approximately 70 years). These benefits are not small. Since there are no alternate supplies of wood to replace this resource if it is not utilized, the loss of this current crop of timber from the area could eventually result in a reduction in production at the Corner Brook mill equivalent to the wood not harvested. At present conversion rates, a reduction of 50-60,000 m^3 per year in raw material will reduce newsprint production by 20,000 tonnes. Harvesting and transporting this volume of wood to the mill provides approximately 60 jobs in the woodlands operations. With present mill technology, processing this wood into newsprint provides another 60 jobs at the mill. The utilization of the forest resource as proposed by CBPPL will directly support some 120 permanent jobs in western Newfoundland. Employment in the forestry sector is high quality employment. Each direct job results in three to four indirect jobs in other sectors of the economy. CBPPL believes that the forest resource in Little Grand Lake can be utilized and the economic and social benefits realized without jeopardizing the integrity of other resource values.

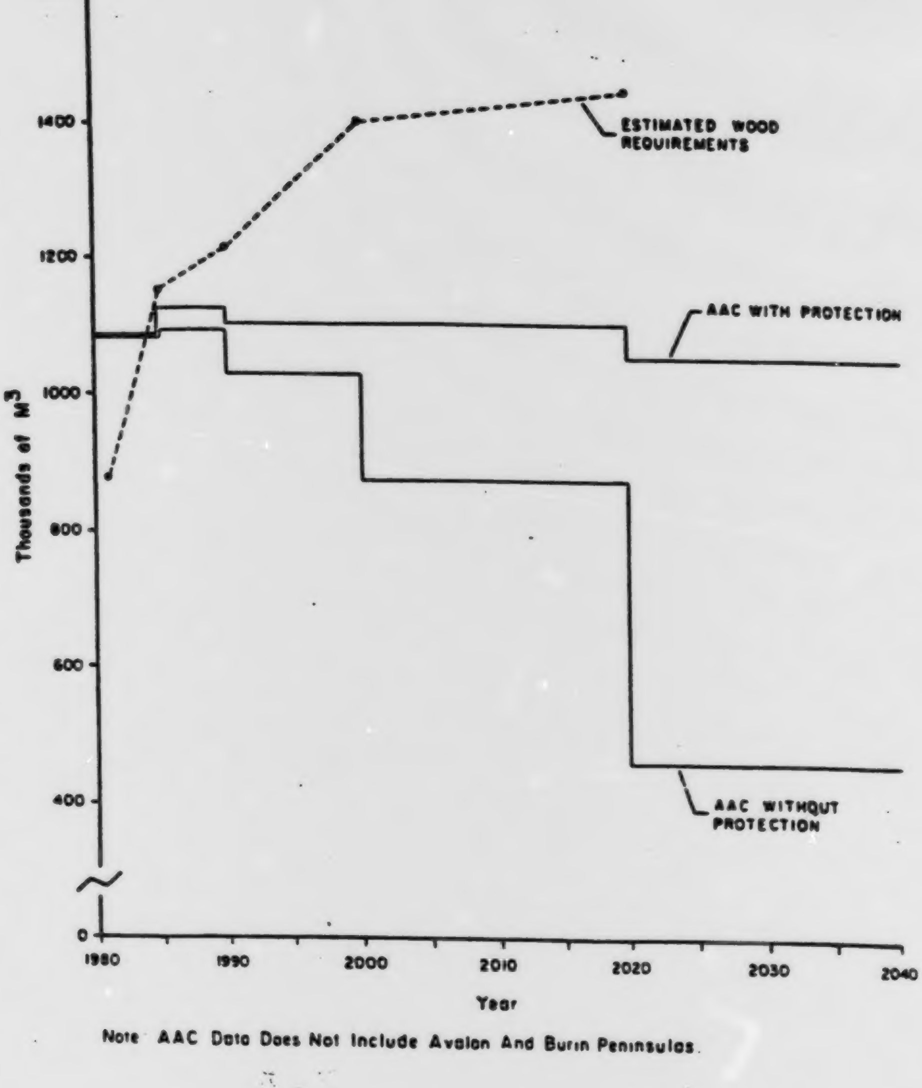
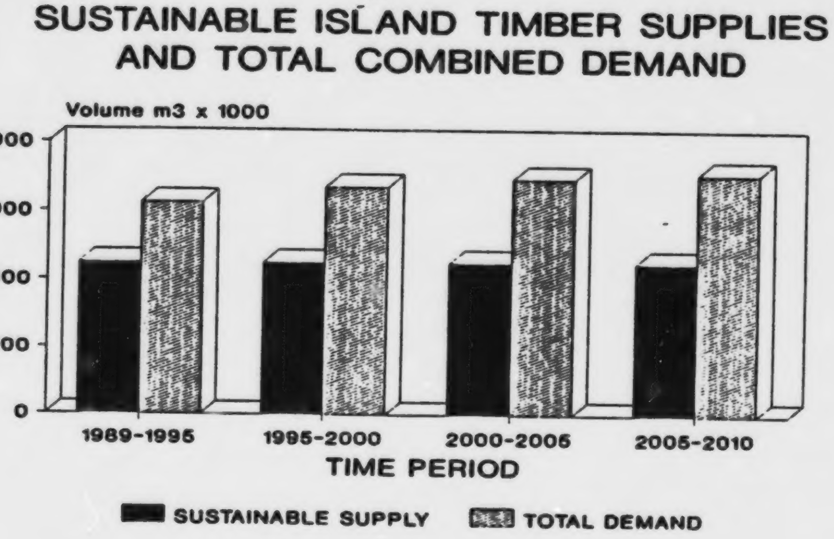


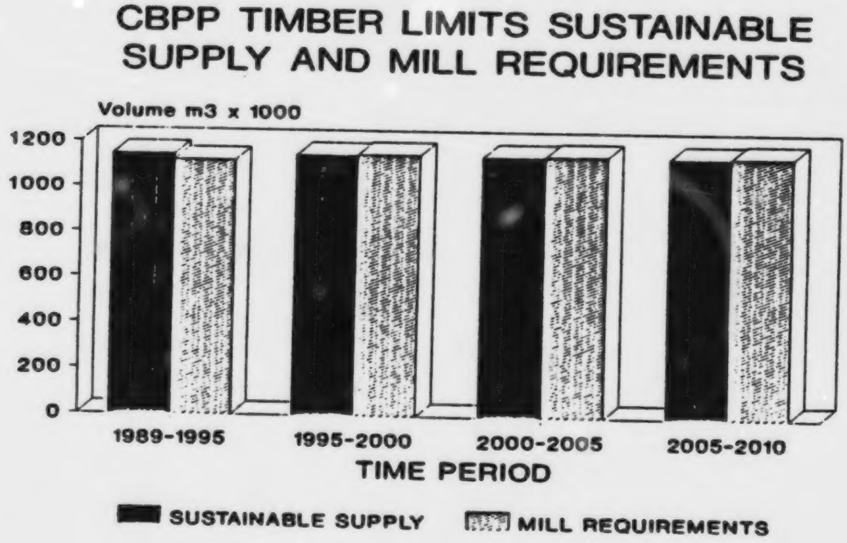
Figure 6

Projected requirements for non-alienated Crown lands and annual allowable cut index conditions of (a) no protection and (b) protection starting 1981. (Source: Poole et al.)



SUSTAINABLE ISLAND TIMBER SUPPLIES AND TOTAL COMBINED DEMAND

Figure 6(a)



CBPP TIMBER LIMITS SUSTAINABLE SUPPLY AND MILL REQUIREMENTS

Figure 6(b)

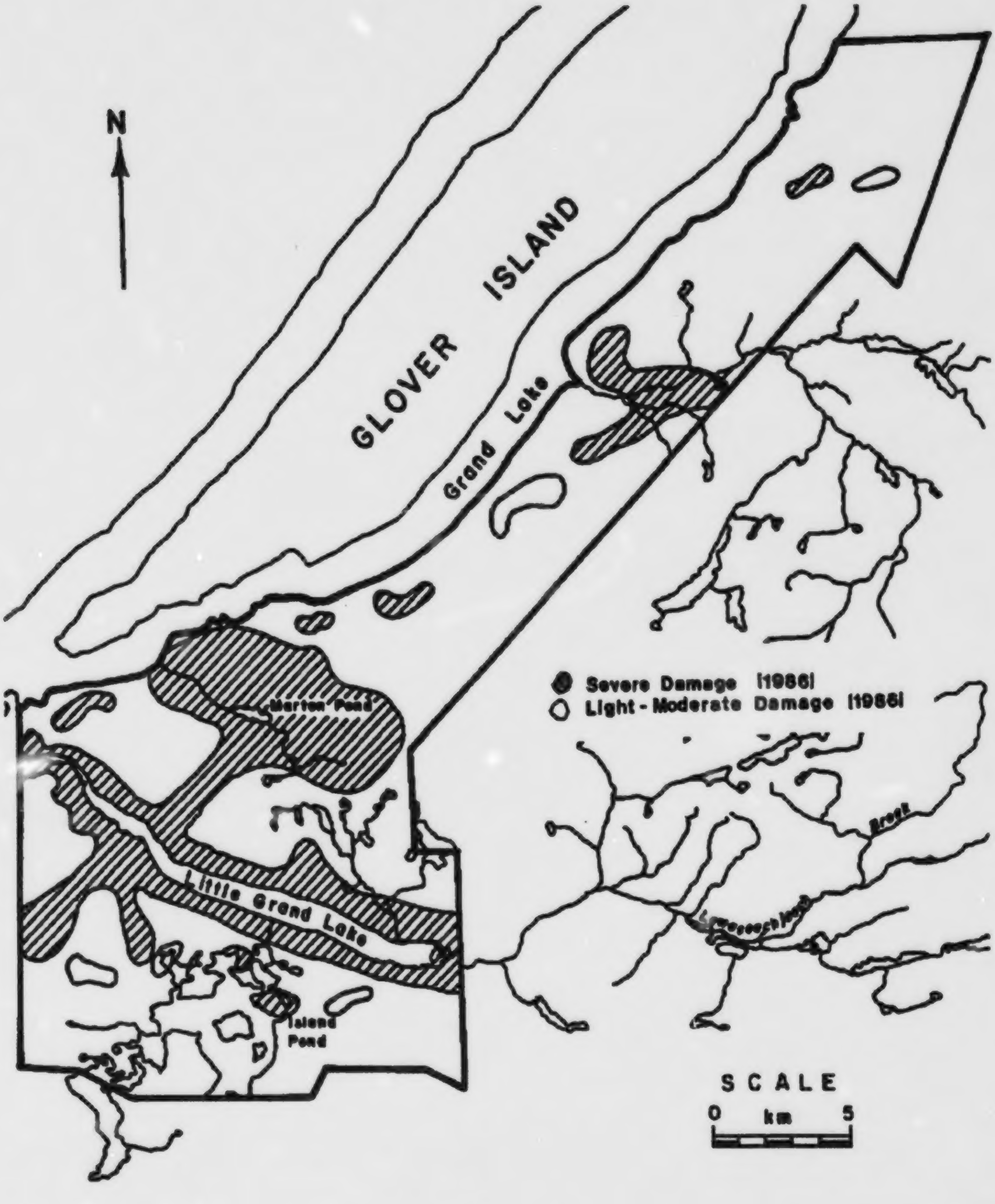

N
GLOVER ISLAND
Grand Lake
Marten Pond
Little Grand Lake
Island Pond
Lewaseechjeech
Brook
● Severe Damage (1986)
○ Light-Moderate Damage (1986)
SCALE
0 km 5

Figure 7

Location of insect damaged forest in the Little Grand Lake study area

3.0 ENVIRONMENTAL SETTING

This section provides original baseline information on the existing environment in the study area as it pertains to the following valued ecosystem components: Newfoundland pine marten; historic resources; and terrain sensitivity.

For purposes of this assessment, it was considered that existing available information was sufficient to evaluate potential impacts of the project on other components of the ecosystem.

3.1 STUDY AREA

The study area is situated within the Western Newfoundland Ecoregion described by Damman (1983). This Ecoregion includes the west coast of the island south of the Great Northern Peninsula and west of the barrens of the southern Long Range Mountains and the Buchans Plateau. The area is heavily forested and has a very rugged topography; elevations in the study area range from 90 m to 600 m.

Information on rare/endangered/unique vegetation in the Little Grand Lake area was sought from the Tuckamoor Society, the Wilderness Society, the Newfoundland Natural History Society, and the Agnes M. Ayre Herbarium. Individuals contacted were Dr. Peter Scott, Dr. Jake Rice, Ms. Lois Bateman and Mr. Henry Mann. None was aware of the presence of such vegetation in the study area.

Slopes bordering the shores of Little Grand Lake and Grand Lake are particularly precipitous. Elsewhere, slopes are less steep and extend from naturally barren hilltops to more fertile river valleys or low areas. Wetlands (peatlands) cover 5-6% of this area. Approximately 60% of the mature forest habitat in the study area has received spruce budworm and hemlock looper damage. Forty percent of these stands are severely damaged or dead (Figure 7). Within 10 years insect-killed forests willresemble cutovers, except that access roads wouldbe absent. Thus, through natural processes, much of the Little Grand Lake study area will lose its present classification as prime pine marten habitat.

CBPPL limits represent approximately 35% of the Environmental Assessment Area (EAA) and approximately 20% of the high density pine marten habitat delineated by the Wildlife Division. The actual area proposed for harvesting by CBPPL represents approximately 10% of the EAA and 5% of the high density marten habitat (Figure 8).

3.2 CLIMATE AND HYDROLOGY

The study area is located on the boundary between the central uplands and the western hills/mountains climatic zones described by Banfield (1981). The brief description of climate presented below is based on averaged values from Stephenville Airport, Corner Brook and Buchans Airport climate summaries since there are no recording stations in the study area. Annual temperatures in this area average 4.5 degrees celsius, with a January mean of -5.9 degrees celsius. The frost free period is about 100 days, and extends from approximately early to mid-June to mid-September. Total annual precipitation averages about 1,100 mm and mean annual snowfall is about 377 cm. The area has an annual average of 191 days with measurable precipitation. Winter has the greatest number of such days, spring has the smallest number. The greatest amount of precipitation in a 24 hour period is 76.9 mm. This occurs in September, almost entirely as rain. An analysis of extreme values for precipitation in this region indicates that this amount of rainfall in a 24 hour period can be expected every 5-10 years, and thus can be considered a normal occurrence.

Table 6 displays selected temperature and precipitation data for the study area on a monthly basis.

Winds in the study area blow most frequently from westerly points, with annual mean wind speed being approximately 20 km/hr. Bright sunshine observations are available from only one location (Stephenville Airport). July is the month with greatest sunshine (206.6 hours), and December the least (32.7 hours).

The Little Grand Lake drainage area is 180 square miles in size. The average annual flow of water out of Little Grand Lake is 601 cfs, with a firm flow of 473 cfs and a secondary flow of 97 cfs (ShawMont Newfoundland Ltd. 1980). The average runoff rate is 3.34 cfs per square mile.

Selected Temperature and Precipitation Data, Little Grand Lake Area

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
Mean Daily Temp (°C)	-5.9	-6.9	-3.4	1.4	6.6	12.2	16.5	16.1	11.7	6.5	2.2	-3.5	4.5
Mean Total Prec (mm)	112.3	85.3	78.8	53.5	67.3	75.8	82.2	99.6	96.2	109.7	121.8	116.0	1096.9
Mean Monthly Snowfall (cm)	93.1	73.8	58.5	28.2	5.1	0.8	0	0	T	5.3	31.1	81.2	377.1
Greatest Prec. in a 24 hour period (mm)	50.1	72.1	41.7	39.8	49.6	51.1	58.2	63.6	76.9	63.9	73.0	44.3	76.9

Table 6

Peak flows on the island of Newfoundland occur during spring (snowmelt and rainfall), with a minor peak in the late fall (rainfall) (Yoxall 1981). Low flows occur during summer (depletion of surface and groundwater storage) and winter (accumulation of snow on the ground, and obstruction of streams by ice). Observations of the water regime in Little Grand Lake during this study confirm that the study area conforms to the discharge patters described by Yoxall (1981).

3.3 GEOLOGY/MINERAL POTENTIAL

The study area falls within the Humber tectonic zone (Williams, 1979), a zone of spectacular geology and physiography, parts of which are of late-Precambrian age. The dominant upland surface of this region of the island is the Long Range Peneplain, a surface created by long-term pre-Cretaceous erosion and not destroyed by the most recent glaciations (Rogerson 1981). The upland surfaces were, however, deeply cut in places by the selective erosion of ice streams moving along pre-glacial river valleys. Grand Lake itself is reported to be of geological (tectonic) rather than glacial origin, but it may have been glacially deepened (Yoxall 1981). Little Grand Lake is transverse to the structural grain of the region, and may be of glacial origin.

The surficial geology of the study area is dominated by bedrock (sometimes concealed by vegetation) and by deposits of glacial origin. Deposits of glaciofluvial and colluvial origin are less common. The deposits exhibit the common range of morphologies. A surficial geology map of the area (NTS 12A/12 Little Grand Lake) has been prepared using the mapping convention developed by the Mineral Resources Division of the Department of Mines and Energy (see Map 3 in pocket at the back of this report).

The Department of Mines and Energy lists 16 mineral occurrences within the study area (Figure 9). None of these appear to hold high promise for development since assay results of grab and/or core samples yielded generally low values. Several other mineral occurrences (including gold showings) are located around the study area, including on Glover Island.

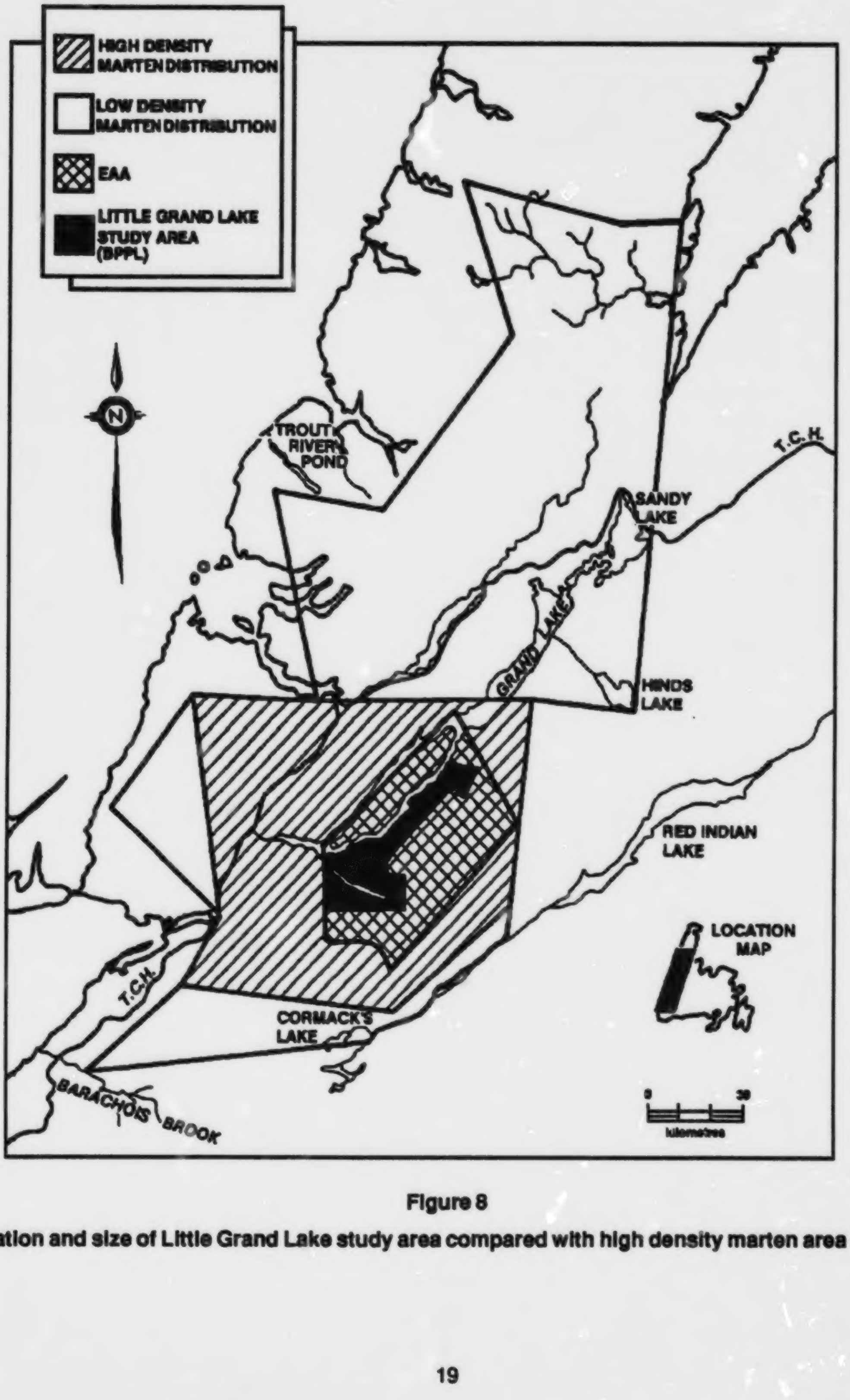

HIGH DENSITY MARTEN DISTRIBUTION
LOW DENSITY MARTEN DISTRIBUTION
EAA
LITTLE GRAND LAKE STUDY AREA (BPPL)
N
TROUT RIVER POND
T.C.H.
SANDY LAKE
GRAND LAKE
HINDS LAKE
RED INDIAN LAKE
LOCATION MAP
T.C.H.
CORMACK'S LAKE
BARACHOIS BROOK
0
30
kilometres

Figure 8

Location and size of Little Grand Lake study area compared with high density marten area and EAA

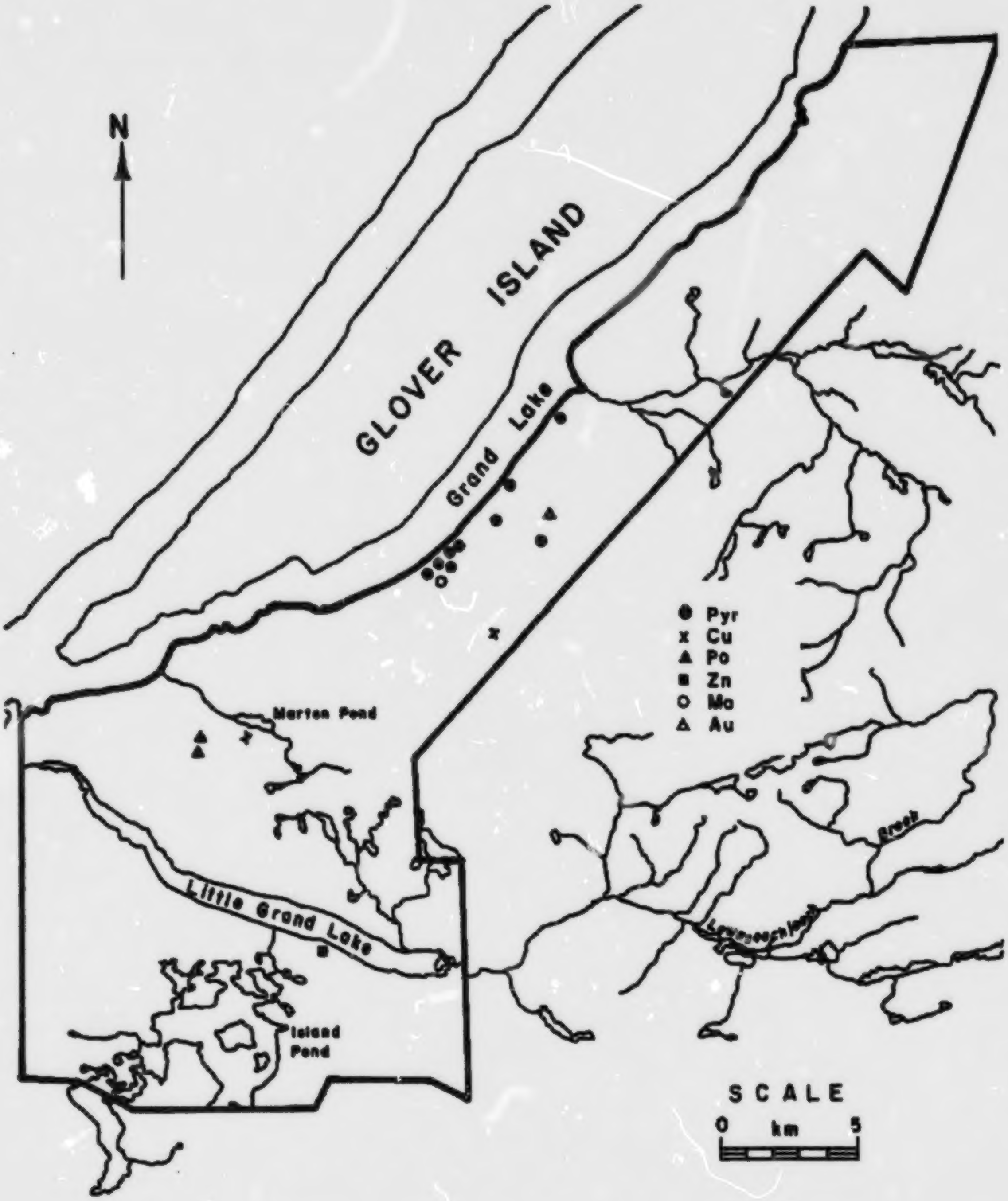

N
GLOVER ISLAND
Grand Lake
Pyr
Cu
Po
Zn
Mo
Au
Marten Pond
Little Grand Lake
Island Pond
Lewaseechjeech
Brook
SCALE
0
km
5

Figure 9

Location of mineral occurrences in Little Grand Lake study area

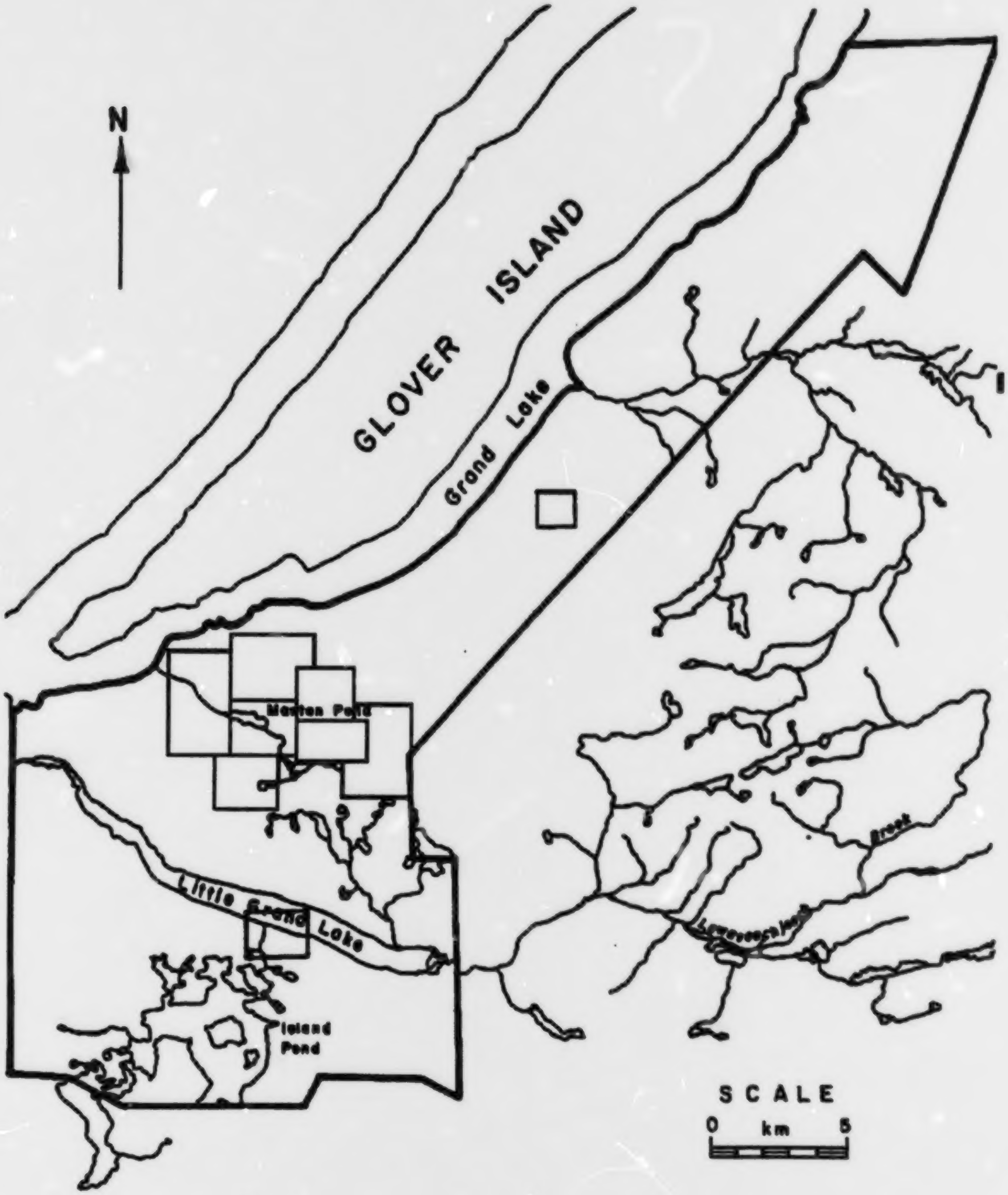

N
GLOVER ISLAND
Grand Lake
Marten Pond
Little Grand Lake
Island Pond
Lewaseechjeech
Brook
SCALE
0
km
5

Figure 10

Location of mineral exploration licences presently in effect for the Little Grand Lake study area

A number of mineral exploration licenses, issued for the study area by the Department of Mines and Energy (Figure 10), remain in effect.

The only quarry permits existing for the area are held by CBPPL. Consequently, no conflict with other users of aggregates is anticipated.

3.4 LAND SYSTEMS CLASSIFICATION

The steep slopes which characterize much of the study area were recognized as locations where erosion might occur following the removal of vegetation and traversing by heavy equipment. It was a requirement of the EIS that CBPPL determine the potential for erosion on this steep terrain.

The determination of terrain sensitivity was undertaken in two stages: Stage 1, identification of potentially sensitive areas on 1:50,000 scale photos, and Stage 2, a more detailed investigation (1:15,840 photography) of those areas identified in Stage 1.

3.4.1 Stage 1

In general, land systems (or ecosections) are defined as regions of recurring patterns of topography, surficial material (e.g. soils), and vegetative assemblages which are geographically and genetically related. The land system classification scheme employed in this analysis is based on five different parameters: slope, relief, surficial material, drainage, and vegetation. Each of these are terrain attributes that can be recognized and mapped using aerial photo interpretation and reference to existing resource maps such as the surficial geological maps and topographic maps.

Relief, a well-known and well-understood geographic concept, is used here to refer to the dispersion of elevation values, or the variability in elevation relative to each land system. The measure relies on the interpretation of both the minimum and maximum elevation values within the system and the average deviation that exists relative to the mean elevation. Relief was analyzed within each system as well as relative to the other systems and classified as low, moderate or high.

The slope of a land system is also well-understood; slope is the magnitude of the gradient or first derivative of elevation in the direction of greatest gradient. Slope also has a directional component called aspect, but this is not considered when interpreting drainage since slope is calculated without reference to direction. Three slope classes were defined: low, 10 degrees, moderate, 11 - 20 degrees, and high, 21 degrees.

Surficial materials present include glacial tills, bedrock, alluvial, colluvial, and organic deposits.

Drainage classes for each system were inferred from the examination of such factors as slope, surficial material, vegetation, and bedrock geology. The variation in drainage within some systems causes assessment difficulties. Decisions concerning drainage class were based on the attributes of the system as a whole.

Vegetation was classified in terms of forest cover and herb/shrub cover. Vegetation classes were selected to reflect the overall quantity of forest cover for each land system and were divided into sparse, moderate, and dense classes for each cover type.

A total of 69 polygons comprising 16 land systems were delineated from the interpretation of 1:50,000 scale black and white aerial photographs. A three unit ranking system (1-low sensitivity, 2-moderate sensitivity, 3-high sensitivity) was used to determine systems which show potential sensitivity to forest harvesting in the area. For forest managers, terrain sensitivity means potential for erosion and alteration of vegetation. The parameters involved in the sensitivity determination are: 1) erodability — a complex variable involving surficial material and topographic characteristics (grain size), 2) drainage — a complex variable based on surficial material topography, bedrock, and vegetation characteristics, 3) slope. Sensitivity is relative; in each case an assessment was made based on the attributes of the system overall and in specific areas marked for harvesting or road location activity. This is a broad-brush sensitivity rating. The occurrence of a high rating for any one parameter within a system would define that system as having a high sensitivity.

Difficulties encountered in determining sensitivity ratings for the drainage parameter are, for the most part, related to the variability of drainage characteristics within certain systems. Drainage may vary within a given system both 1) spatially, and 2) in degree. In the first case a system was defined as being sensitive if; i) the system as a whole had a poor drainage rating, or ii) drainage was poor in areas marked for forest operations.

A degree of error is present in any subjective interpretation. In this study, errors of commission are likely to be high because areas in doubt with regard to environmental sensitivity were included as being sensitive. The scale of the project may also have resulted in errors. The variability within some land systems with respect to the parameters for classification and sensitivity rating introduce a degree of inconsistency to the overall scheme. For example, while slope and relief are relatively straightforward, drainage may be quite complex and must, for purposes of this study, be analyzed at the system level and at the level of the subsets comprising the system.

Land Systems

A description of the land systems within the study area follows. Figure 11 shows the distribution of the systems which are potentially sensitive, and Table 7 summarizes their characteristics and indicates their frequency of occurrence.

Land System 1 — Treed Bog

This system is characterized by low relief and low slopes composed of poorly drained organic surficial deposits. Forest cover is sparse while herb and shrub species dominate the vegetation of the area. The system is found primarily in the northern regions of the study area.

Land System 2 — Sphagnum Bog

Poor drainage, extensive organic deposits, and low relief/low slopes clearly delineate this system. Its occurrence varies from depressions on mountain tops to poorly drained areas around lakes and streams. Vegetation is generally herb/shrubs/-sphagnum; forest cover, if present, is stunted. This system is relatively common throughout the study area.

Land System 3 — Subglacial Drainage Channels

Land System 3 has a moderate relief and relatively gentle slopes. The glacial till deposits are very well drained and have a dense forest cover. This singly occurring system is situated in the northeastern section of the study area.

Land System 4 — Forested Mountain Tops

This system is characterized by undulating topography, moderate relief, and low slopes. A dense forest cover is present over the well drained till/bedrock surficial deposits. This system occurs throughout the study area.

Land System 5 — Forested Footslopes

Gentle slopes, low relief, and poorly drained till/organic surficial deposits characterize this system. A dense forest cover is dominant; however, patches of organic material and associated herb and shrub vegetation are present. This land system is limited with respect to both frequency and location, occurring in the northeastern portion of the study area.

Land System 6 — Colluvial Slopes

The high relief, relatively steep slopes of this system are well drained and densely forested. Colluvium is the primary surficial material present. The colluvial slopes are found adjacent to the major lakes in the area.

Land System 7 — Forested Uplands

This system is dominated by low relief and gentle slopes. The till deposits are well drained and have a dense forest cover. This system is relatively common and is generally confined to the northeastern portion of the study area.

Land System 8 — Alluvial Valleys

The alluvial/organic/till surficial deposits of this system give rise to a sparse forest cover which tends to be confined to well drained areas; a dense herb/shrub/organic cover is present in the poorly drained areas. Topographically, the area has low relief and is generally flat. It is evenly distributed throughout the area and is associated with land systems 10, 8, and to a lesser extent, Land System 7.

Land System 9 — Upland Drainage Slopes

This system has moderate relief and gentle, poorly drained slopes. The surficial till/organic/alluvial deposits give rise to a moderate forest cover. Herbs and shrubs account for the remainder of vegetative cover. This system is found throughout the study area and in some cases is associated with Land System 8.

Land System 10 — Moderate Slopes

The densely forested, till/colluvium slopes of this system have a moderate relief and are very well drained. This system is the most frequently occurring and is most commonly associated with land systems 8 and 16.

Land System 11 — Vegetated/Bedrock Terrain

This land system has a moderate relief with mainly low slopes. The area is characterized by a sparse forest cover and more extensive organic cover over the poorly drained bedrock/till surficial deposits. This system has a single occurrence in the northeastern part of the study area.

Land System 12 — Patterned Forest/Bog Uplands

Alternating bog and forest areas comprise this relatively low relief/low slope system. The poorly drained surficial deposits include bedrock, till, and organic. This land system has one of the largest areal extends and occurs in the central portion of the study area.

Land System 13 — Rock/Bog Uplands

Topographically, this system is dominated by gentle slopes and a relatively low relief. The exposed bedrock and organic deposits are poorly drained. Vegetation is mainly herb and shrub species. This system has a single occurrence in the central portion of the study area.

Land System 14 — Rock Knob Uplands

This system is characterized by a knobby, high relief topography and relatively low slopes. The area is well drained and has a moderate forest cover with areas of exposed bedrock and bog. This system occurs in the central and western parts of the study area.

Land System 15 — Glacial Decay Area

High relief and gentle, forested slopes are characteristic of this system. Side slopes are predominantly till and are well drained, while depressions comprise poorly drained organic deposits. A single occurrence of this system is situated in the southern portion of the study area.

Land System 16 — Rock Barrens

This system has a knobby, high relief, relatively low slopes, and is sparsely vegetated. The relatively well drained nature of the bedrock appears to be related to extensive fracturing in the area. This system is frequently occurring and can be found in the southern part of the study area in association with Land Systems 10 and 8.

Table 8 shows the potential sensitivity of the land systems at the Stage 1 level of assessment. Figure 11 shows the location of those potentially sensitive systems which are targeted for harvesting or road building. Map 4 (back pocket) delineates the potentially sensitive areas in more detail.

3.4.2 Stage 2

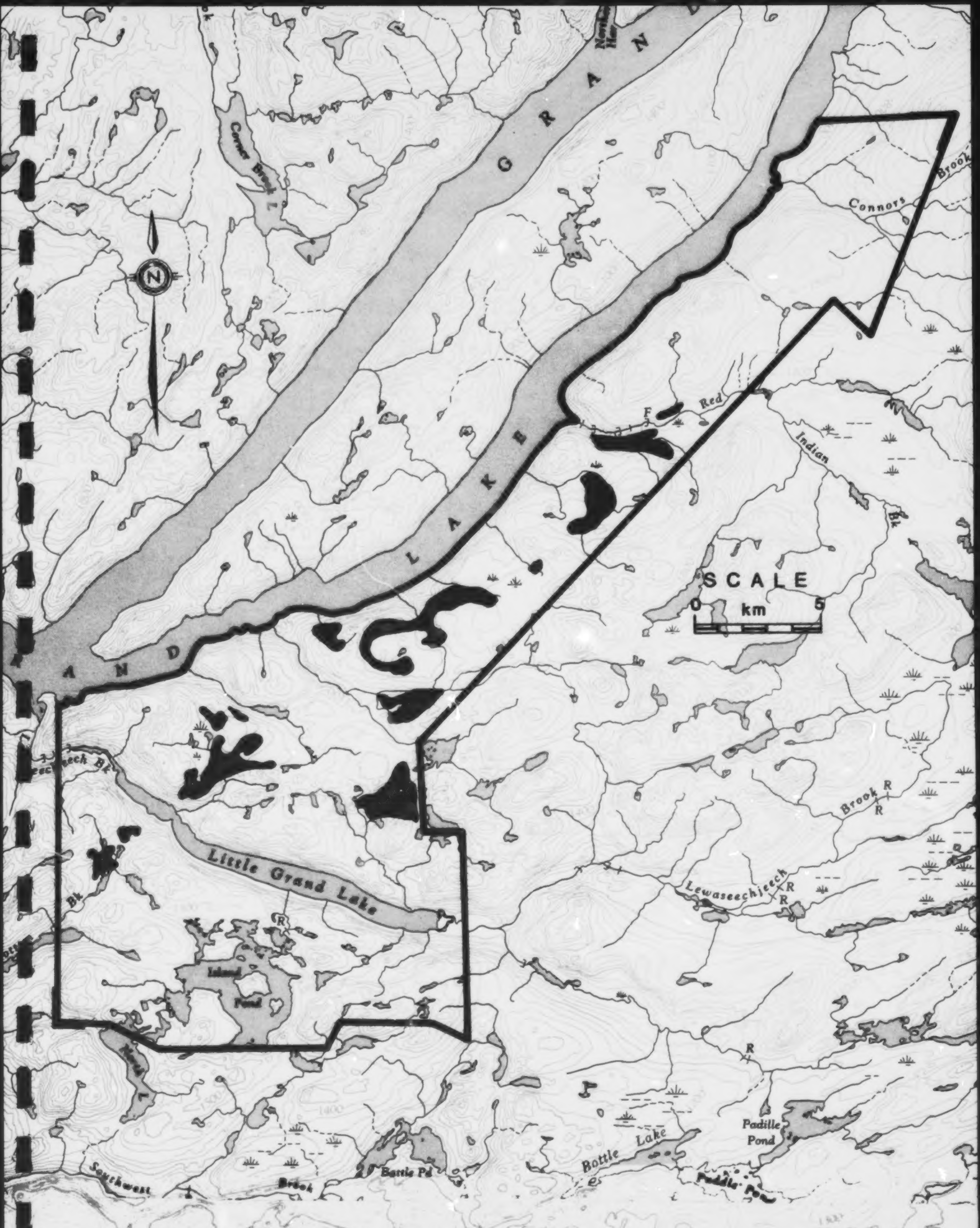
Introduction

In this interpretation, large scale aerial photographs of selected areas within previously mapped (Stage 1) Land Systems are examined in detail. In the Stage 1 interpretation, areas of potential environmental sensitivity to forest harvesting techniques are delineated from the interpretation of small scale black and white aerial photography and mapped at a 1:50,000 scale. The region was divided into distinct land systems comprising areas of recurring patterns of topography, surficial material, and vegetative assemblages. These land systems were then classified in terms of potential environmental sensitivity based on categories of slope, erodability of surficial material, and drainage, relative to the range of conditions observed. The boundaries of areas of potential sensitivity were the result of merging land systems containing terrain elements deemed ecologically sensitive with areas designated for harvest. There were 21 areas of potential sensitivity mapped at the 1:50,000 scale. The scale of the project, nature of the sensitivity rating, and the variability of terrain possible within each land system resulted in a broad-brush classification scheme which erred on the side of commission (that is, areas of reasonable doubt, at that scale, were included as being sensitive). This was in anticipation of the more detailed land unit examination using larger scale aerial photography.

A more detailed investigation was undertaken in order to: (1) refine and/or redefine areas of potential sensitivity, and (2) clarify and elaborate on the sensitivity ratings. The areas were mapped and transferred to 1:30,000 scale Newfoundland and Labrador Forest Inventory Map. Table 9 lists the land systems identified as potentially sensitive,

Figure 11

Distribution of Stage 1 potentially sensitive terrain within the Little Grand Lake study area


GRAND LAKE
Corner Brook L
Connors Brook
Red
F
Indian Bk
SCALE
0 km 5
Little Grand Lake
Island Pond
R
Bk
Lewaseechjeech Bk
Lewaseechjeech
Brook
R
Padille Pond
Bottle Lake
Bottle Pd
Southwest Brook
Paddle Pond
N

Potentially Sensitive Land Systems (Stage 1) in Little Grand Lake Study Area

Land System	Relief	Slope	Surficial Material	Drainage	Vegetation		Frequency
					Forest	Shrub/Herb	
1	low	low	organic	poor	sparse	dense	5
2	low	low	organic	poor	sparse	dense	5
3	mod	low	till	very good	dense	sparse	1
4	mod	low	till bedrock	good	dense	sparse	11
5	low	low	till	poor	dense	sparse	1
6	high	high	colluvium till	very good	dense	sparse	5
7	low	low	till	very good	dense	sparse	4
8	low	low	alluvium organic till	poor	sparse	dense	5
9	mod	low	alluvium organic till	poor	moderate	moderate	4
10	high	low	colluvium till	very good	dense	sparse	12
11	mod	low	bedrock organic till	poor	sparse	moderate	1
12	low	low	organic till	poor	moderate	moderate	1
13	high	low	bedrock organic	good	sparse	moderate	1
14	high	low	bedrock till	good	moderate	sparse	2
15	high	low	organic till	good	dense	sparse	1
16	high	low	bedrock	good	sparse	moderate	10

Table 7

Land System Environmental Sensitivity (Stage 1)

	Sensitivity		
	1	2	3
	low	moderate	high
Erodability	coarse	medium	fine
Drainage	very good	good	poor
Slope	10	11 - 20	21

Land System	Erodability	Drainage	Slope	Sensitivity
1	3	3	1	high
2	3	3	1	high
3	1	2	1	low
4	1	2	1	low
5	2	3	1	high
6	2	1	3	high
7	1	1	1	low
8	3	3	1	high
9	3	2	1	high
10	2	1	2	low
11	2	3	1	high
12	2	3	1	high
13	2	3	1	high
14	1	2	1	low
15	2	2	1	low
16	1	2	1	low

Table 8

their frequency of occurrence, and the frequency of occurrence of areas which retained the sensitive rating after detailed analysis. A major objective of this detailed study was to reduce the importance of relative sensitivity criteria and employ an absolute rating for sensitive areas. Our presentation of this interpretation follows the earlier "extended legend format" accompanying the maps.

Figure 12 shows the general location of areas considered to be potentially sensitive at the Stage 2 level of assessment. Map 4 (back pocket) provides more detail.

Among the sites no longer deemed to be sensitive are four of the six occurrences of Land System 9 (Upland Drainage Slopes). This system was originally determined to be sensitive on the basis of drainage. Sensitive sections extend from the edge of the organic and stream features to the limit of merchantable timber — this is in essence, a natural buffer observed in forestry field operations which serves to protect these areas.

Similarly, the sites classed as Land System 8 (Alluvial Valleys) were flagged in the 1:50,000 mapping as being sensitive on the basis of both drainage and erodibility. Again, the absence of commercial forest forms a natural buffer zone along the stream banks, organic terrain, and all drainage features of a significant size which should minimize the effects due to forest harvesting operations.

Six areas have maintained their sensitive rating after detailed air photo study. These are: single occurrences in each of Land Systems 6 (Colluvial Slopes) and 12 (Patterned Forest/Bog Uplands), and two occurrences in each of Land Systems 9 (Upland Drainage Slopes), and 13 (Rock/Bog Uplands).

From the detailed analysis, these areas delineated as demonstrating potential sensitivity to forest harvesting practices share several common characteristics. Each area possesses a complex drainage pattern comprising a combination of organic wetlands, ponds, lakes, and streams. A relatively large percentage of these areas are organic wetlands adjacent to areas designated for harvest.

The areas defined as being potentially sensitive to forest harvesting procedures represent areas of overall sensitivity. Within the entire Little Grand Lake region, other specific sites require proper planning and caution. Precautions will be taken to ensure minimal environmental damage, particularly near water bodies and during the design and construction of roads.

A detailed description of each area deemed sensitive, and worthy of special consideration, is presented in the Impact section.

3.4.3 Post Logging Assessment of Sensitive Site A

When Stage 2 of the Land System Classification was complete, it was discovered that one of the potentially sensitive areas (Area A, Figure 12) had been cut over in 1986 as part of the experimental block for the pine marten study. In July 1988, approximately two years after the cut, Area A was visited to evaluate the condition of the site.

To determine the nature of the disturbance on Area A, three parallel transects spaced 50 m apart were run across the central section of the cutover perpendicular to the general direction of the main skidder road through the cutover. At 25 m intervals along each transect, the amount of ground disturbance within a 1 m^2 plot was noted. A total of 20 plots were examined, and disturbance indices recorded as outlined in Case and Donnelly (1979).

In addition, the main skidder road through the cutover was examined at 25 m intervals to determine the type and extent of disturbance.

Ground disturbance on the cutover was caused by skidding operations. However, the amount of disturbance on the cutover transects was not very severe; 70% (14 plots out of 20) of the area was rated as virtually undisturbed (Figure 13A). Five plots (25%) were rated as light disturbance, and one plot (5%) was sufficiently disturbed to be classed as moderate. The light and moderate ratings were on plots adjacent to the skid road. The light disturbances were characterized by the exposure of the detritus layer (F layer), while the single moderate disturbance displayed inverted pieces of the organic layer.

Compaction was not in evidence on any of the 20 transect plots across the cutover. Case and Donnelly (1979) reported that less than 10% of their 164 ha cutover study location on the steep slopes along the east side of Grand Lake displayed compaction. These same investigators also found less ground disturbance (86% undisturbed) on their Grand Lake cutover than this present study recorded for Area A (70% undisturbed).

The main skidder road through the cutover showed a considerable amount of ground disturbance (Figure 13B). Four of the six plots (66.6%) along this road were classed as having heavy disturbance, ranging from exposure of mineral soil in the deep skidder ruts, to muck development and some minor gully erosion. The remaining two road plots were described as having moderate disturbance.

The high amount of terrain damage on the main skidder road through the cutover was due in large part to poor road location; the most heavily damaged sections of the road ascended the slope almost at right angles to the contour. Damage was

Frequency of occurence of Stage 2 potentially sensitive land systems in Little Grand Lake Study Area

Sensitive Land Systems	Frequency of Env. SensitiveAreas	Frequency of Areas Sensitive to Harvesting
6	1	1
8	8	0
9	6	2
12	1	1
13	5	2
Total	21	6

Note:		
	Column 1	Land systems deemed sensitive at 1:50,000 scale mapping.
	Column 2	Frequency of occurrence of environmentally sensitive areas at 1:50,000 scale mapping.
	Column 3	Frequency of occurrence of areas sensitive to forest harvesting operations (1:15,840 scale mapping).

Table 9

lighter where the road crossed the slope with only a small deviation from the horizontal.

The major access and haul road into the study area shows no deterioration in the 2-3 years since its construction. The driving surface is in excellent shape, and the roadside ditches show no evidence of gullying. The low angle of deviation from the horizontal as it crosses the contours is one reason the road has stood up well (Figure 13C).

In addition to evaluating Site A, older cutovers adjacent to the study area were examined. These older areas showed good softwood regeneration and little evidence of ground disturbance (Figure 13D).

3.5 FISHERIES RESOURCE

Despite its size, there is little resource base information available on the aquatic environment of the study area. Water quality data are limited, however Scruton (1984) provides spatial distribution maps of water quality parameters for the province based on 1060 stations in Newfoundland and 410 in Labrador. Of these, approximately eight are in the watershed of Grand Lake — Little Grand Lake. The range of values reported for the area is given below (Table 10), and indicate that the waters are typical of western Newfoundland, i.e. very soft water, slightly acidic and with low buffering capacity. The conductivity values indicate moderate quantities of dissolved materials and hence moderately productive waters.

The Hinds Lake Environmental Impact Statement (Hydro, 1978) includes limited data on water quality for Grand Lake and describes the lake as oligotrophic. Both data sets indicate a pristine water quality, with no indication of pollution or contamination.

Figure 12

Location of Stage 2 potentially sensitive terrain within the Little Grand Lake study area

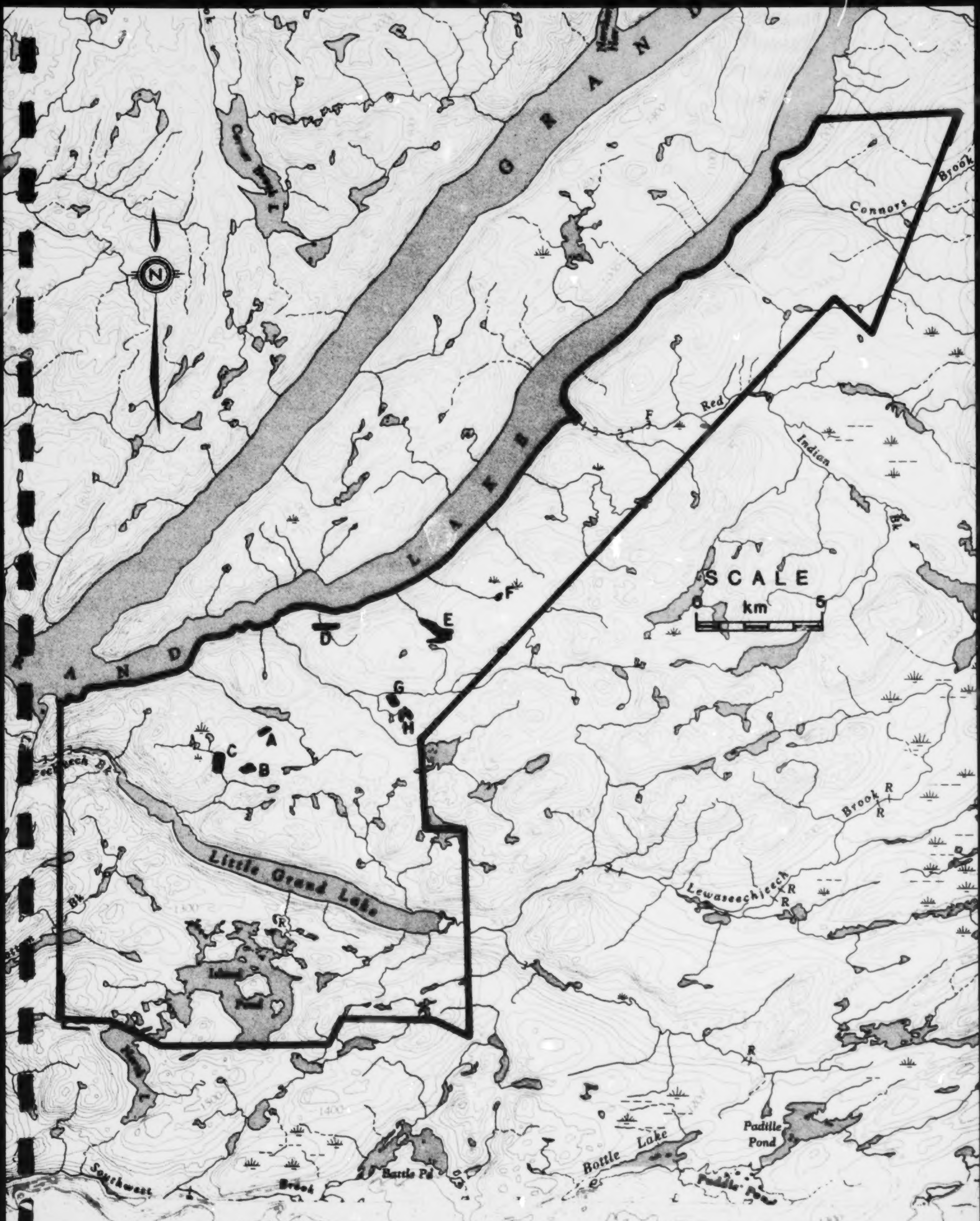

GRAND LAKE
N
Connors Brook
Red Indian Brook
SCALE
0 km 5
A
B
C
D
E
F
G
H
Little Grand Lake
Island Pond
Lewaseechjeech Brook
R
Bk
Southwest Brook
Battle Pd
Bottle Lake
Padille Pond
Paddle Pond
1400
1800

Figure 13

Little Grand Lake area, 1988

A. Surface of cutover, Site A

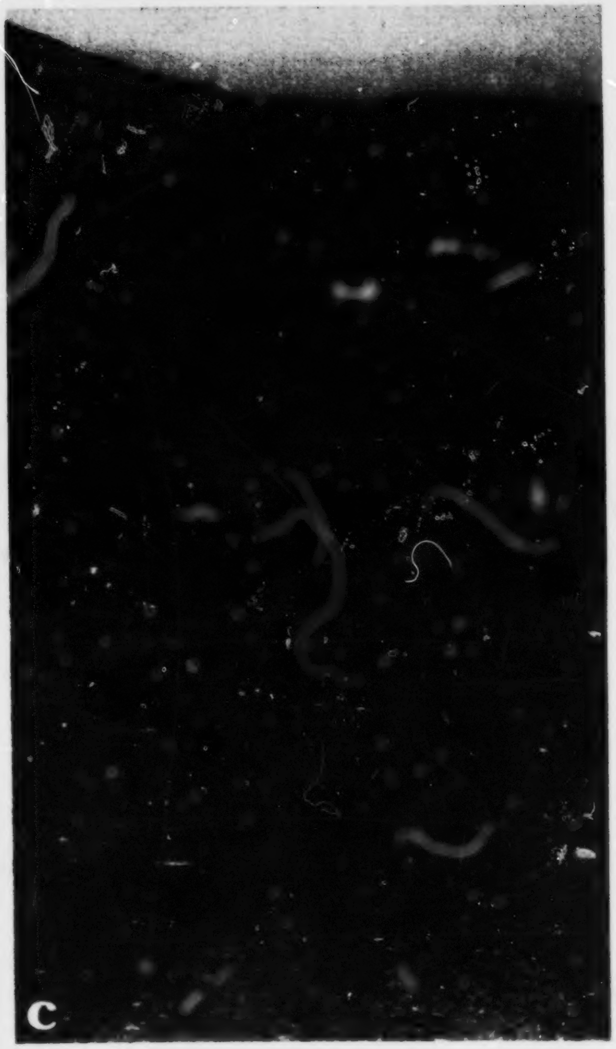
B. Main skidder road through Site A

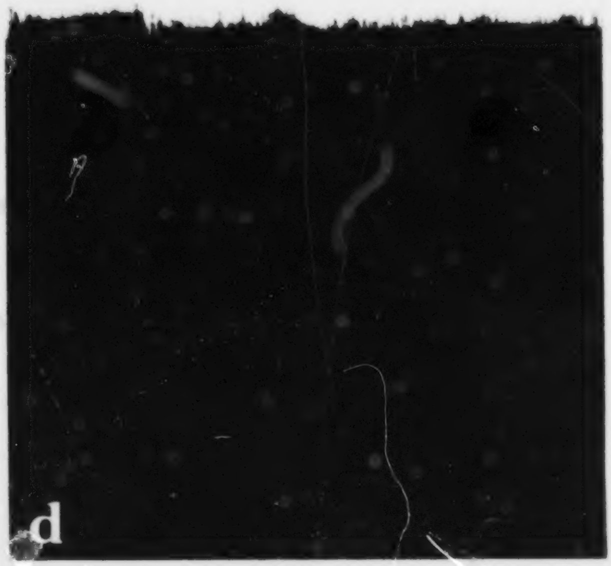
C. Major access road to the study area

D. Six year cutover adjacent to study area

a

b


c


d

Water Quality, Grand Lake Area

Parameter		Units	Data Source	
			Scruton, 1984	Hydro, 1978
pH			5.5 - 6.5	6.9
Alkalinity		mg/l	10 - 14	9.80
Hardness		mg/l	4.0 - 14.0	11.68
Conductivity		uS/cm	20 - 40	35.44
Bicarbonate		mg/l	10 - 18	—
Total Dissolved Solids		mg/l	—	13.0
Colour	Total	TCU	20 — 40	—
	Apparent		—	15
Nutrients				
Kjeldahl Total Nitrogen		mg/1	—	0.292
Nitrate Nitrogen		mg/l	—	0.101
Total Phosphates		mg/l	—	0.092
Ortho Phosphate		mg/l	—	0.009
Silicate		mg/l	—	0.372
Chemical Oxygen Demand		mg/l	—	17.14
Biochemical Oxygen Demand		mg/l	—	<1.0
Tannin/Lignin		mg/l	—	0.026
Sulphate		mg/l	1 - -1.5	—
Chloride		mg/l	4 - 6	—
Metals				
Sodium		mg/l	0.5 - 1.5	1.844
Calcium		mg/l	4.0 - 10.0	3.386
Magnesium		mg/l	0.25 - 1.0	0.726
Manganese		mg/l	—	
Iron		mg/l	—	0.051
Copper		mg/l	—	
Zinc		mg/l	—	0.021
Cadmium		mg/l	—	
Lead		mg/l	—	
Potassium		mg/l	0.5 - 2.0	0.262

Table 10

Officials of the Department of Fisheries and Oceans in Corner Brook (Jack Marshall, pers. comm.) reported that the area has not been surveyed to document fish species present, nor are there inventory data available on aquatic habitat.

Prior to the development of the Deer Lake Hydroelectric Generating Station, Grand Lake was accessible to anadromous Atlantic salmon, however the run to this section of the Humber River watershed is now extinct. There is no information available on the nature or size of that run. Newfoundland and Labrador Hydro (1978) reported catches of ouananiche (*Salmo salar*), brook trout (*Salvelinus fontinalis*), and three-spined stickleback (*Gasterosteus aculeatus*) from Hinds Lake, a system draining into Grand Lake. It is likely that these species also are present in Grand Lake and Little Grand Lake. As well, it can be expected that arctic char (*Salvelinus alpinus*) are present in the two lakes since this species is commonly reported in large lakes throughout insular Newfoundland.

Both ouananiche and brook trout utilize stream habitat for spawning and rearing of juveniles, and move into standing water during later life stages. The ideal situation is a watershed containing streams with spawning gravel and moderate gradient so that there is no barrier between the two (lentic and lotic) habitat types. Where habitat choices are limited, the entire life cycle can be completed in either flowing or standing water, however this usually results in some limitation to growth or survival reflecting this aquatic habitat limitation.

The ideal standing water habitat is a relatively shallow water body with high shoreline development (i.e. convoluted shoreline with many islands, coves and peninsulas). It is the area of light penetration in the water body (the photic zone) which provides production in any water body either through plankton in the water body, or on the bottom (benthos). This production provides fish food.

Both Little Grand Lake and Grand Lake appear to have limited productive capacity for salmonid species. The inflow tributaries are steep and most have barriers (falls, rapids) which prevent upstream movement of fish for spawning. The water bodies themselves appear to have little shoreline development and an abrupt bathometry, so that the photic zone is quite limited.

Under such conditions it can be expected that populations are probably modest in numbers and growth rates low. It is probable, however that a proportion of older fish (brook trout and ouananiche) adopt a piscivorous (fish-eating) diet. As a consequence, the growth rate of these individuals is accelerated and large, trophy-sized fish are produced. Such a situation has been reported by Pippy (1966) for Victoria Lake. Nevertheless, the production per unit area is probably quite modest.

3.6 WILDLIFE RESOURCES

While all wildlife resource groups (big game, waterfowl etc.) are dealt with in this EIS, the focus is on pine marten. The results of the two-year study of marten in the Little Grand Lake area are presented in a separate component report (Bissonette *et al.* 1988); but as is custom, much of the information in the component study is also used in the EIS document.

3.6.1 Pine Marten

3.6.1.1 History of Marten in Newfoundland

Historically, marten were distributed throughout the boreal forests of North America (Hagmeier 1956). On the island of Newfoundland marten were once found in most forested areas, although probably never in great numbers (Bergerud 1969, Snyder 1985). By the early 1900's, marten populations had begun to decline (Snyder 1984). Prior to 1934 they were trapped commercially, but by 1934 were sufficiently rare to necessitate the closing of the trapping season. It has never been reopened. In eastern Newfoundland, remnant populations of marten were probably extinct by 1969 (Bergerud 1969). The eastern chipmunk (*Tamiasstriatus*) and the red squirrel (*Tamiasciurus hudsonicus*), introduced into western Newfoundland in 1962 and 1963 respectively, were alternate prey species which may have enabled the marten to survive in the east. However, these species would not have dispersed (certainly not in large numbers) to eastern Newfoundland by 1969.

In 1973, provincial Wildlife Division personnel considered the only remnant population of marten in Newfoundland to be concentrated in the Grand

Lake — Little Grand Lake area of western Newfoundland; (Mayo 1975, 1984; Snyder and Hancock 1982). As a result of rising concern, the Pine Marten Study Area (PMSA, Figure 14) was created in 1973 by the Government of Newfoundland and Labrador to offer protection for the marten. Within this area, which includes approximately half of the high density marten area identified in 1985 (Snyder and Hancock 1985, Figure 8), all trapping and snaring were prohibited to protect marten from accidental capture. It was hoped that the PMSA would act as a refuge from which marten would eventually disperse and colonize other areas of suitable habitat. Whether or not this has happened is debatable; relatively high densities of marten are still found in the Grand Lake — Little Grand Lake area, and relatively large numbers of marten have been reported outside the area. In the 1980-83 period, western Newfoundland trappers reported sighting or trapping at least 75 marten; 65 (87%) of these were outside the PMSA (Figure 15) (Hancock *et al.* 1983). This suggests that the Little Grand Lake area may not have been the only remnant marten population in 1973, or that the PMSA did function as a refuge from which marten did disperse to other areas of suitable habitat.

In another initiative by the Wildlife Division, marten were introduced into the headwaters area of the La Poile River (Mayo 1976a), the Main River area (Mayo 1976b), Siviers Island (Porter 1976), and Terra Nova National Park (Bateman 1985) in attempts to establish other populations. It appears that the introductions to Siviers Island and La Poile River have been unsuccessful. Marten have been reported from the Main River area since 1976, but it is not certain if their presence is due to the introduction,or if they were there beforehand (Hancock, pers. comm., 1987). The introduction into Terra Nova National Park is still being assessed, but three of the eight marten relocated are known to have died after being accidentally caught in traps outside the park. Due to the long term gradual decline resulting in drastic reductions in distribution and numbers, marten in Newfoundland have been designated as "threatened" (Snyder 1985).

Why was the marten never more abundant in insular Newfoundland, and what are the factors that contributed to the initial decline of the island population? There appear to be three major factors: poor food base, trapping, and habitat disturbance. The limited food base probably kept marten populations from building to a more secure population level; the species has always been on the edge of decline in Newfoundland. The limited food base drops even further during cyclic lows of the prey species. In such periods of food scarcity there is a general dispersal of resident animals, and the already low reproductive rate of the marten becomes even lower. The increased movement during the periods of food scarcity make marten more vulnerable to trapping. And the surviving animals were probably unable to rebuild the population to its former level before the next cycle of prey scarcity arrived.

Trapping of marten in Newfoundland was thought to have been excessive in the early 1900's (Bissonette *et al.* 1988), and was perhaps the major cause of the initial decline of the island population. Most of the damage had been done by the time the species was placed on the protected list in 1934. Except for some remnant populations marten had likely disappeared from central and eastern Newfoundland by that time.

Habitat disturbance, while probably not a major contributing factor in the initial decline, did play a substantial role in it. Marten prefer dense, mature coniferous forest or mixed forest with high overstory density (Bateman 1986, Clark and Campbell 1976, de Vos 1952, Douglas *et al.* 1983, Francis and Stephenson 1972, Hargis 1982, Koehler and Hornocker 1977, Koehler *et al.* 1975, Marshall 1951, Pullianinen 1981, Raine 1983, Soutiere 1979, Spencer *et al.* 1983). The reasons for this preference are not clearly understood, but overhead cover and prey abundance and availability appear to be involved (Bissonette *et al.* 1988). Consequently, habitat disturbance or loss by such factors as fire and insect damage created conditions which were not suitable for marten. Central Newfoundland was swept by a number of major forest fires during and after the construction of the trans-island railway around the turn of the century (Page *et al.* 1974), and these fires may have had a substantial effect on marten distribution and numbers.

Wildfires did, of course, occur in Newfoundland forests before the construction of the railway.

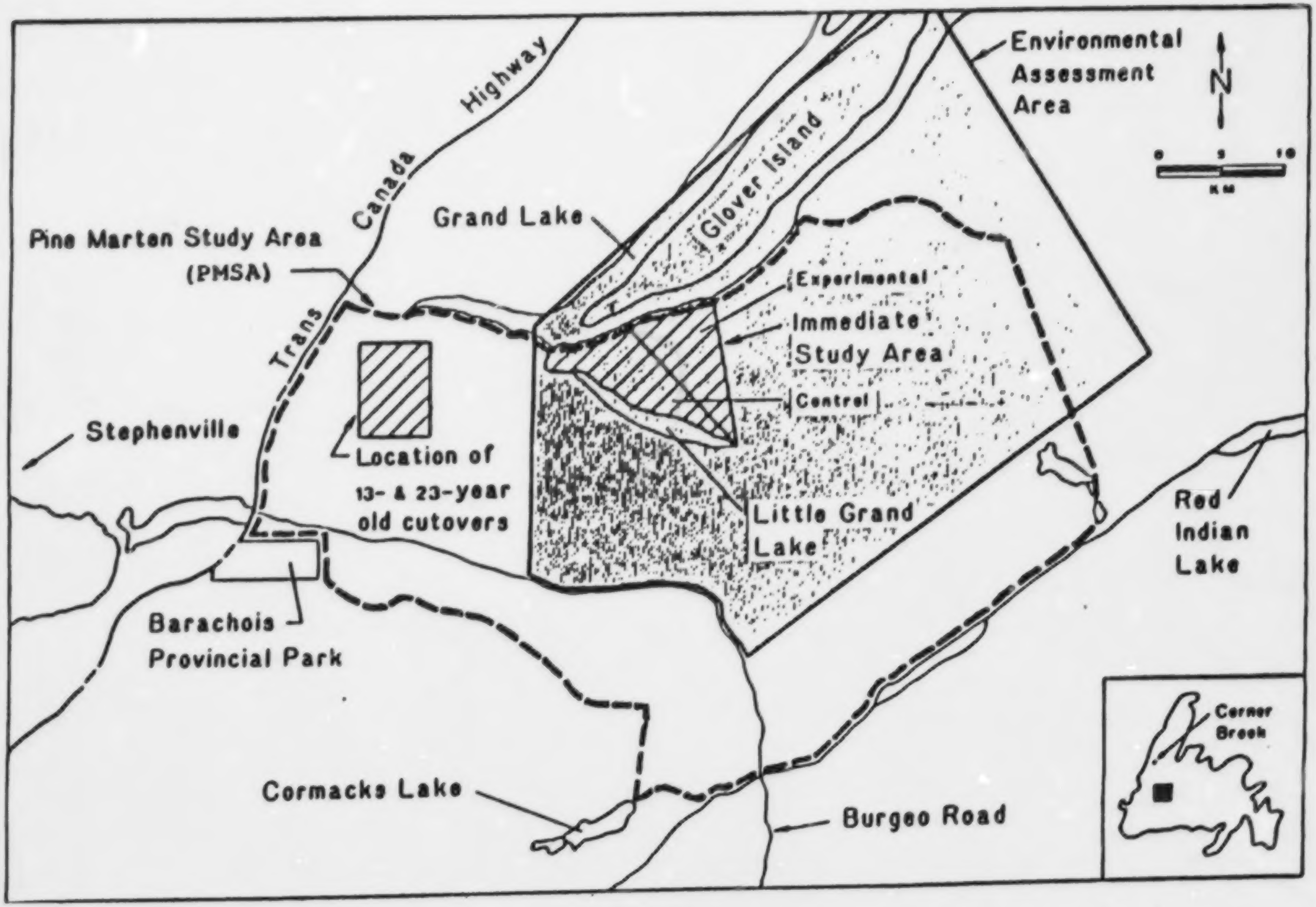

Environmental
Assessment
Area
N
0 5 10
KM
Highway
Canada
Trans
Grand Lake
Glover Island
Pine Marten Study Area
(PMSA)
Experimental
Immediate
Study Area
Control
Stephenville
Location of
13- & 23-year
old cutovers
Little Grand
Lake
Red
Indian
Lake
Barachois
Provincial Park
Corner
Brook
Cormacks Lake
Burgeo Road

Figure 14

Pine marten study area (PMSA) in western Newfoundland (Source: Bissonette et al.)

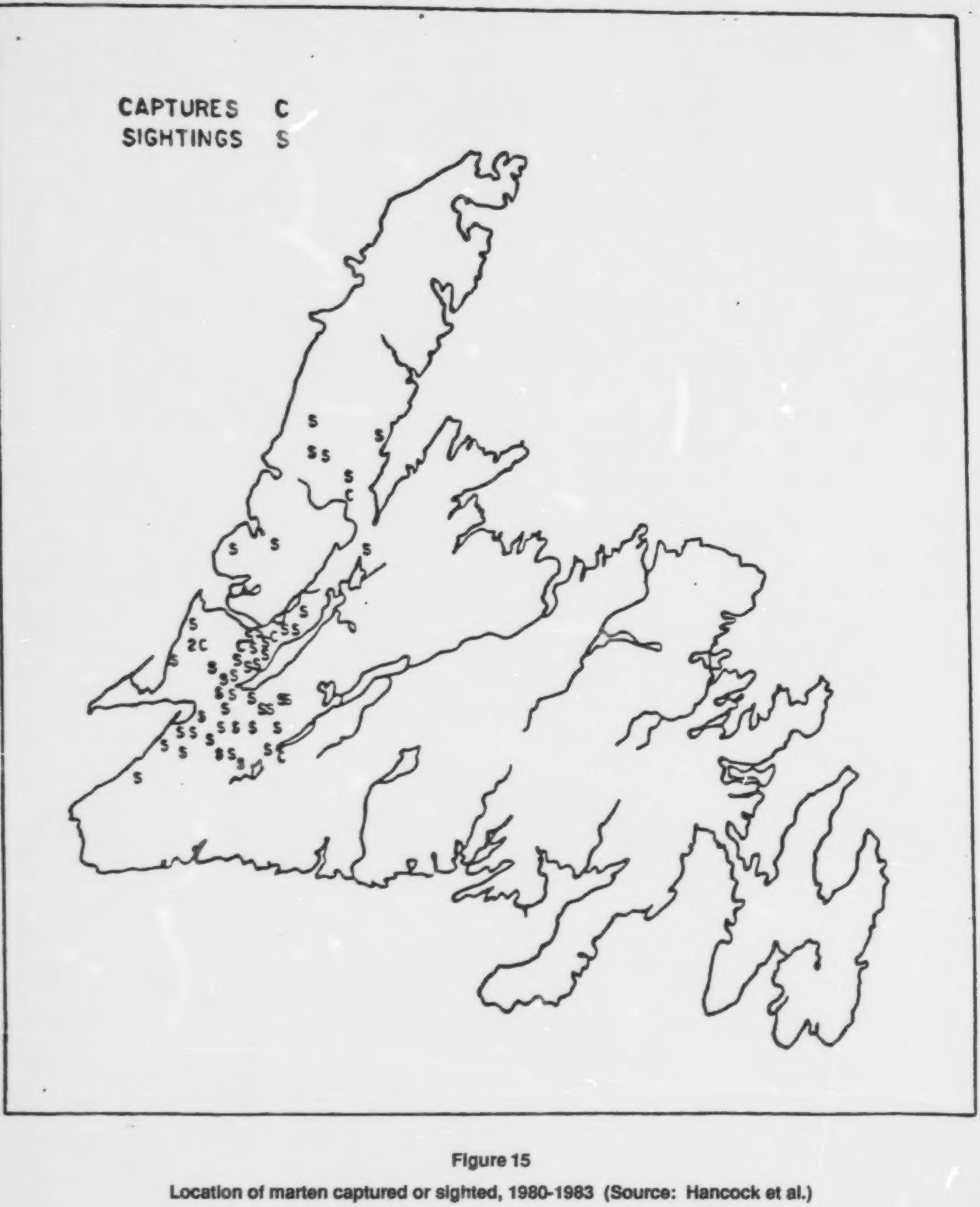

CAPTURES C
SIGHTINGS S
2C

Figure 15

Location of marten captured or sighted, 1980-1983 (Source: Hancock et al.)

However, in their review of the history of forest fire in Newfoundland, Wilton and Evans (1974) state that fires were rather infrequent in pre-railroad days; mature and over-mature forest covered much of the island. Nevertheless, extensive areas of productive forest were burnt in some pre-railroad years.

Throughout the 1619-1960 period examined by Wilton and Evans (1974), the pattern was one of periodic intensive conflagrations followed by longer periods of light burning. The central portion of the island, with its somewhat drier and warmer summers, displayed the greatest hazard for forest fire. Coincident with the building of the railway and for several decades after that, the central region was swept by a number of conflagrations until there was scarcely any land that had not been burned on at least one occasion.

The forest fires which occurred in 1904 were more destructive than in any previous year in Newfoundland's history (Wilton and Evans 1974). In that year, large portions of the island from coast to coast were swept by fire: in all, over 2,000,000 acres of productive and non-productive forest were destroyed, with the central and western regions being hardest hit.

Wilton and Evans (1974) calculate the area of productive forest land burned between 1910 and 1970 (one forest rotation) as 1,400,000 acres or 15 percent of the present productive forest area. During that same period another 2,000,000 acres of non-productive forest land was burned, for a total of 3.5 million acres or approximately one-eighth of the land area of the island.

Wilton and Evans (1974) focus most closely on the period after 1910. We felt it would be informative to examine the 50-year period prior to 1910, and therefore consolidated (by decade) the central and western Newfoundland listings in Wilton and Evans:

> 1860s: Succession of devastating fires, particularly in central Newfoundland. Approximately 2,000 square miles (1,280,000 acres) of mature forest were reported destroyed around Gander Lake in 1867 alone.
>
> 1870s: Many large fires in central Newfoundland. Extensive tracts of timber destroyed in the area between Sheffield Lake and Halls Bay.

1880s: During the decade, fires described as "very extensive" to "immense" were reported for the Halls Bay, Sandy Lake and Bonavista Bay (Terra Nova) areas.

1890s: One of the worse decades for fires in central and western Newfoundland. In six consecutive years (1893-1898) fires described as "very extensive", "devastating the country", leaving the country a "blackened waste", and "extending for 60 miles" were reported for Terra Nova, Halls Bay, White Bay, Norris Arm, Badger, Bay of Islands, Benton and Glenwood.

1900-1910: Another decade of damaging forest fires:

1900:	Extensive area burnt between Deer Lake and Bonne Bay.
1901:	50 square miles (32,000 acres) burnt around Norris Arm.
	Fire burned in vicinity of Grand Lake for one week.
	The village of Glenwood burned, and an extensive area of forest destroyed.
1903:	Large fire in heavy timber near Deer Lake.
1904:	Many serious fires across the island: "fires prevalent all summer", "whole country ravaged".
1908:	Extensive fire near Deer Lake.

It is clear from these data that as much productive and non-productive forest land may have been burned from 1860-1910 as from 1910-1970. As a consequence of such habitat destruction, marten numbers would have likely declined naturally, and distribution may have been altered in such a manner that local concentrations were created, and these were then exploited by trappers. Add to this the fact that insect outbreaks have been reported on the island since records were first kept (early 1900's). Thus there was major habitat disturbance, particularly by fire, about the same time (early

1900's) that a decline in marten population level was first reported.

Habitat disturbance by logging may also have been a factor in the initial decline of marten; but the contribution was probably a minor one, and resulted primarily from the sawmilling practice of removing only the larger trees. The first large sawmill in Newfoundland was established at Botwood (north-central Newfoundland) in 1890, and by 1900 a number of other large sawmills were operating in the central region of the island (Page *et al.* 1974). Logging for pulpwood began with the establishment of the Grand Falls paper mill in 1909. For the first 10 years of its operation the mill procured its wood supply by following the highgrading practice of sawmillers. By the time the Grand Falls mill adopted the clear-cut technique for logging (about 1920), marten numbers had already declined significantly in eastern and central Newfoundland.

The opening of the Corner Brook paper mill in 1925 would not have contributed significantly, if at all, to the initial decline of marten in Newfoundland. The population was already known to be in decline at that time, and logging would not have disturbed extensive areas of marten habitat between 1925 and 1934 (when numbers were so low that the species was protected). In fact, marten had disappeared from the Main River valley about this time; the Main River area had been trapped but never logged or burned.

Habitat disturbance through human settlement probably contributed very little to the initial decline of marten populations. No great amount of land base was disturbed by the development of the central and western Newfoundland communities. Firewood cutting and the limited amount of agriculture that reached out from the communities likewise would not have much of an impact. The single community-based activity that would have put pressure on marten populations is trapping.

Another factor possibly contributing to the initial decline of the marten population in Newfoundland is disease. Bissonette *et al.* (1988), who lost a number of their Little Grand Lake study marten to a disease tentatively diagnosed as non-suppurative encephalitis, suggest that recurring disease may have been a factor in the early decline of marten.

If these factors have contributed, in varying degrees, to the early decline of marten in Newfoundland, are the same factors also responsible for what is seen as failure of marten populations to recover to the early 1900's level? A resolution to this question, or part of this question, is sought in this EIS; a major objective of the EIS is to assess the potential impact of forest harvesting operations on pine marten in the Little Grand Lake area, and to determine if these harvesting operations represent an obstacle to the recovery of marten populations in western Newfoundland.

3.6.1.2 Study Area and Methods

The two-year pine marten component study was carried out in an area of old growth forest interspersed with ponds, bogs and barrens located between Little Grand and Grand Lakes (Figure 16). (See Figure 14 also.)

Marten were live-trapped in collapsible live traps, ear tagged and fitted with radio transmitter collars. Home ranges of individual animals were determined by plotting locations obtained from radio telemetry, live trapping, snow tracking, and visual observation, and applying the harmonic mean statistical method to these data to delimit home range boundaries.

Age of marten was determined by cementum analysis of the sectioned and mounted first premolars extracted from live-trapped animals. Sex and age ratios were calculated using trapping data. Population and productivity estimates were made using collared marten.

Feeding habits of marten were determined primarily through scat analysis; determinations were based on frequency of occurrence of items in the scats.

Since it was a goal of this study to evaluate the impact of actual on-going logging activity on marten, not just to assess the reaction of marten to clear-cuts after the activities had ceased, CBPPL began limited harvesting operations in the study area on August 4, 1988. Guidelines for this harvesting were worked out by the Wildlife Division and CBPPL. The section of the study area in which the cutting took place became the "experimental" zone, the uncut portion of the study area functioned as the "control" zone (Figure 14). Marten

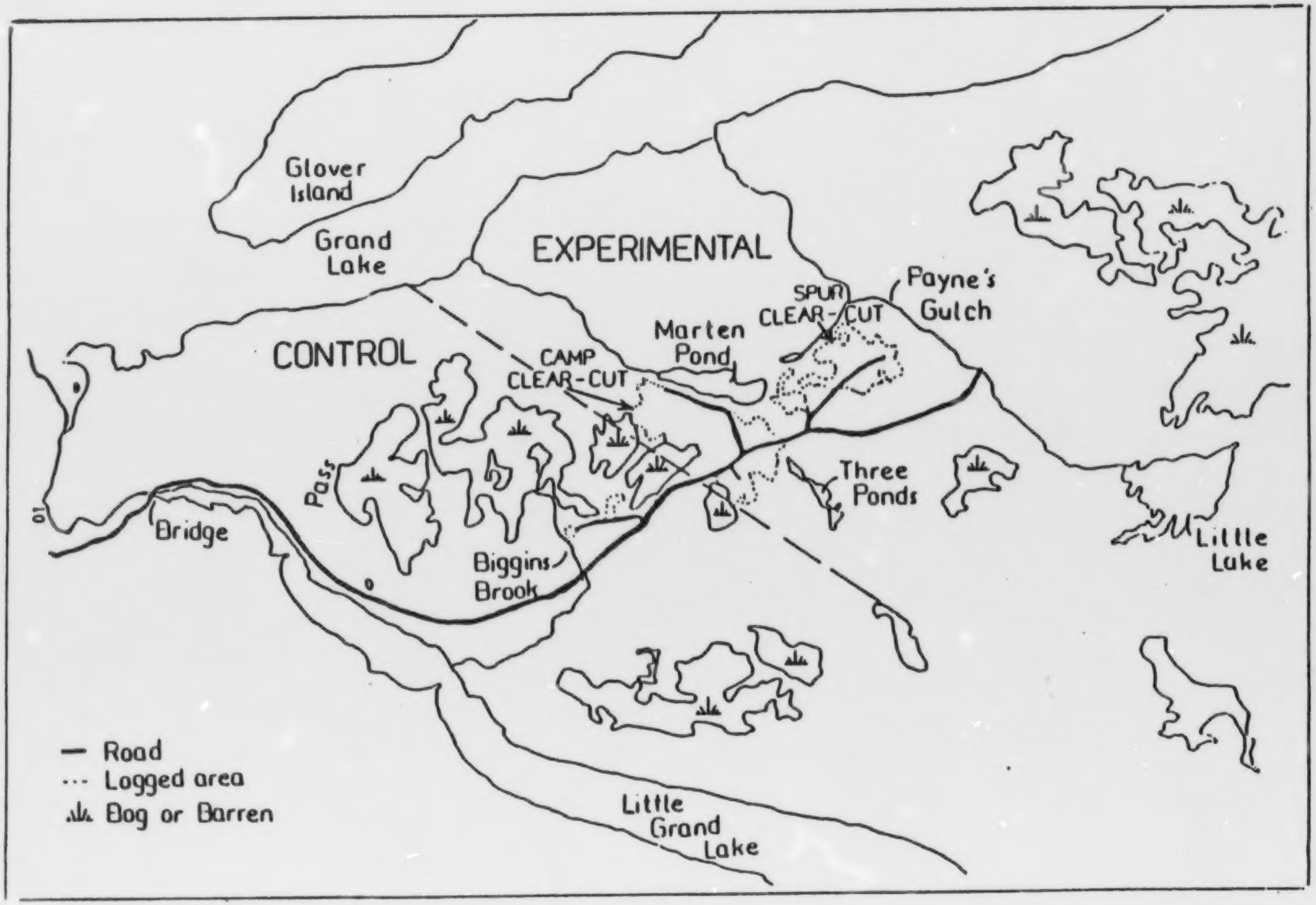

Glover Island
Grand Lake
EXPERIMENTAL
CONTROL
SPUR CLEAR-CUT
Payne's Gulch
Marten Pond
CAMP CLEAR-CUT
Three Ponds
Little Lake
Pass
Bridge
10
Biggins Brook
Little Grand Lake
— Road
··· Logged area
ılı Bog or Barren

Figure 16

Location of study area for 2-year pine marten study (Source: Bissonette et al.)

captured in each zone were thus designated "experimental" and "control" animals.

Details of the methodology used in this study can be found in Bissonette *et al.* 1988.

3.6.1.3 Results

Between November 1, 1985 and August 15, 1987 a total of 4,126 trap nights resulted in 243 captures of 43 different marten (Table 11). Ten marten were captured only once. Five were captured outside the study area and were never found to cross into the study area; these animals are not included in Table 11. Thirty-five marten were fitted with radio collars. Home range and habitat use findings for 10 marten are presented in this report. Of these, only three (#28, 34, 42) provided useful information for pre-logging, logging and post-logging comparisons. The remaining seven marten provided radio signals for one or two (or parts thereof) of the three logging regimes, and this information may be of limited value for comparing the home range and habitat use before, during and after logging. Table 12 shows the time frame over which the instrumented marten provided radio signal location data for the study carried out by Bissonette *et al.* (1988).

Home range dynamics

Marten home range size, core area size (core areas are those areas within a home range where use exceeds that expected from a uniform distribution), and spatial patterns were dynamic, adjusting to the presence or absence of neighbours, colonization by new marten, the presence of rich food sources during lean times, the decline of the small mammal prey base, and the alteration of their habitat by clear-cutting (Bissonette *et al.* 1988). A summary of the home range dynamics and habitat use during the study by the 10 key marten follows.

Marten # 28, 34 and 42 provided information throughout all phases of the study.

#28 (Male, Control)

This marten frequented the researchers' camp on the edge of a clearcut so regularly in the winter of 1986 that the camp became the animal's centre of activity. The home range did not change during logging, with both control and experimental areas being used during this period. In the post-logging period, the home range was expanded to take in a large portion of the experimental area including the clearcut (the former range of marten #29) and the researchers' camp. Although marten 28 was observed crossing the clearcut, most of its post-logging activities were confined to the forest and forest edge adjacent to the clearcut.

Change in home range size: Marten 28 doubled its range after logging to include areas that were cut. This was not a relocation of range, but an expansion of an existing control home range to include an equal amount of experimental territory.

#34 (Female, Experimental)

The pre-logging home range of this animal was centered around Three Ponds, just south of the area to be logged by CBPPL as part of the marten study. Just prior to the commencement of logging activities, #34 abandoned its Three Ponds range and moved north. The new home range was located to the north and east of Marten Pond, and included a large block of timber scheduled for clear cutting.

Marten 34 remained in its new range throughout the logging activity, and in the post-logging period continued to occupy the range impacted by logging. Approximately 40% of the range was clearcut, but while #34 did cross these areas, and even used a subnivean den in a clear cut to rest, her use of clearcuts was limited. She continued to use her new range, and three months into the post-logging phase she was killed by a predator.

After #34 abandoned her Three Ponds territory in favour of an area to the north, marten #49 moved into the experimental area around Three Ponds and established a home range similar in size and orientation to that of the former occupant.

Change in home range size: marten 34 did not alter the size of her home range, rather she relocated her home range from one part of the experimental area to another before logging activities began. The new home range size (determined after logging began) was 25% smaller than the pre-logging old home range.

#42 (Male, Control)

This marten continued to use its home range in the control area during and after logging as it did in the pre-logging period. Except for frequent forays into

Marten captured at Little Grand Lake, 11/85-86/87

No.	Name	Sex	Born	1st Capture
13.	Bunny [1,2]	F	'81	5-29-86
28.	Ern	M	'84	11-1-85
29.	Wes	M	'81	11-1-85
30.	Edgar	M	'84	11-5-85
31.	Gary	M	'84	11-6-85
32.	Joyce	F	'85	11-7-85
33.	Cliff	M	'77	11-7-85
34.	Nika [1]	F	'81	1-22-86
35.	Theresa	F	'85	1-23-86
36.	Slu	F	'85	1-23-86
37.	Brutus	M		1-23-86
38.	Pasadena	F		1-30-86
39.	Elaine	F	'82	2-19-86
40.	Brent	M		2-23-86
41.	Paul	M	'84	2-27-86
42.	Ken	M	'85	5- 6-86
43.	Doug	M	'80	5-18-86
44.	Kevin [2]	M		5-19-86
45.	Barbie	F		5-26-86
46.	Jerry	M	'85	6-18-86
47.	Diane [2]	F	[3]	7- 9-86
48.	Cheryl	F	'86	7-15-86
49.	Christine	F	'85	7-26-86
50.	Jim	M	'86	7-27-86
51.	Clint	M	'86	7-23-86
52.	Al	M	'86	8-11-86
53.	Fiona	F	'86	9-13-86
54.	Arnie [2]	M	'86	9-15-86
55.	Ashley	F	'86	9-19-86
56.	Found dead	M	'86	9-19-86
57.	Found sick [2]	F	[4]	10- 7-86
58.	Misty	F	'86	10-19-86
59.	—	F	'86	10-28-86
60.	—	F	'86	10-30-86
61.	—	M	[4]	11-1-86
62.	Verne	M	'86	11-1-86
63.	Desiree	F	'86	11-5-86
64.	Kirk	M	'86	11-6-86
65.	Jake	M		12-5-86
66.	Alice	F	'86	1-29-87
67.	Tina	F	'86	3-13-87
68.	Vanna	F	[4]	5-23-87
69.	Kim	F	[4]	7-29-87
70.	Elwood	M	'86	7-29-87
71.	Kelly	F	'86	8- 4-87

[1] First captured in 1982.
[2] Captured outside the study area.
[3] Probably a kit, no tooth pulled.
[4] Tooth extracted, age confirmation pending.

(Source: Bissonette *et al.* 1988)

Table 11

Table 12

Time frame for marten captured on study area

```
No.              Pre-logging                  Post-logging
        1985          1986                 1987
        N  D J  F M  A  M J | A  S  O N | D J F M  A  M J  A
____________________________________________________________
28.      *____________________________________________________
29.     *___________________---------X
30.     *
31.     *
32.     *_________________________-----____X
33.     *
34.     . . . *______________-------______________X
35.     . . . *______________---_____X
36.     . . . *_X
37.     . . . *_X
38.     . . . *
39.     . . . . *___________________-X
40.     . . . . *
41.     . . . . *
42.     . . . . . . . . *_____________________________________
43.     . . . . . . . . *_______________X
45.     . . . . . . . . *____X
46.     . . . . . . . . . *-----------__________-------_______
48.     . . . . . . . . . . *________X
49.     . . . . . . . . . . *_____________________X
50.     . . . . . . . . . . *________X
51.     . . . . . . . . . . *___________X
52.     . . . . . . . . . . . . *----______X
53.     . . . . . . . . . . . . . . *______X
55.     . . . . . . . . . . . . . . *
56.     . . . . . . . . . . . . . . *
58.     . . . . . . . . . . . . . . .*
59.     . . . . . . . . . . . . . . .*
60.     . . . . . . . . . . . . . . .*
61.     . . . . . . . . . . . . . . . . *
62.     . . . . . . . . . . . . . . . . *
63.     . . . . . . . . . . . . . . . . *
64.     . . . . . . . . . . . . . . . . *
65.     . . . . . . . . . . . . . . . . . . *
66.     . . . . . . . . . . . . . . . . . . . .*_X
67.     . . . . . . . . . . . . . . . . . . . . . . *
68.     . . . . . . . . . . . . . . . . . . . . . . . . *_____X
69.     . . . . . . . . . . . . . . . . . . . . . . . . . . . *__
70.     . . . . . . . . . . . . . . . . . . . . . . . . . . . *__
71.     . . . . . . . . . . . . . . . . . . . . . . . . . . . . *
```

*	First capture.
X	Died or disappeared from study area.
___	Producing radio signal on study area.
--	Present on study area, but uncollared or not producing signal.

the range of #28, marten #42 exhibited no tendency to permanently expand its range or to relocate it. The main harvest access road passed through the home range, including the core area, of this marten.

Change in home range size: Decrease of approximately 13%.

The seven remaining marten provided information to the study for one or two (or parts thereof) of the three logging regimes. For various reasons (death, disappearance etc.) the impact of logging on home range size was determined for only one animal (#49).

#29 (Male, Experimental)

Most of the area logged by CBPPL as part of the Little Grand Lake marten study was within the home range of this animal. Its radio collar ceased to function in June, 1986 and thus there were no detailed logging and post-logging movement and home range data available for this marten. However, live trapping and visual observations showed that #29 continued to occupy the experimental area, including the site of the researchers' camp during the early phase of the logging operation. It died of disease in the experimental area in October, 1986.

After his death, much of #29's home range was taken over by #28; the two had overlapping home ranges at the time they were first captured.

#32 (Female, Control)

This animal was quite conspicuous in its use of the area around the researchers' camp. In spite of being less than one year old, #32 maintained a stable home range. During much of the logging period her collar was not functioning, and she died or disappeared from the study area in January, 1987 at the beginning of the post-logging phase of the study.

#39 (Female, Control)

From a well established home range adjacent to the western end of Little Grand Lake in the control area, this marten moved into the experimental area in the summer of 1986 to occupy the Three Ponds range formerly held by #34. Although there are insufficient radio locations to give a home range during logging, #39 probably did not remain in the Three Ponds area for a long period; in October of 1986 she was found dead of disease on the south side of Little Grand Lake.

#46 (Male, Control)

Marten #46 was captured in the fall of 1986, but the radio collar did not function properly until midway through the logging phase. The signal locations since that time indicated that this marten continued to use the same range during and after logging.

#49 (Female, Experimental)

Marten #49 was captured in the Three Ponds area just prior to the logging phase of the project. Home range information provided for the logging and post-logging phases showed that this animal occupied range impacted to some degree by logging, including cutovers and heavily travelled haul roads.

After logging, # 49 shifted her home range eastward, and then disappeared in May 1987.

Change in home range size: home range size increased by 15% from the logging to post-logging period.

#50, 51 (Males, Experimental)

These two sibling kits were captured on the experimental area just before logging operations began. They continued to occupy the area during the early part of the logging activity, staying close together and sometimes travelling across cutovers. Marten 50 disappeared from the study area in October 1986, #51 in November 1986. The logging phase ended on November 7, 1986.

The before, during, and after logging home ranges and core areas for these marten are shown in Figures 17 to 21.

Summary of home range dynamics

None of the five experimental marten discussed above left the study area during the approximately three months (August 4 - November 14) of logging in 1986 (#50 disappeared from the area near the end of the logging phase). All five of the control marten remained in the study area (some crossed from the control to the experimental portion of the study area) during logging, but one (#32) disappeared and another (#39) died of disease shortly after.

Only three of the ten marten provided sufficient radio signals to compare pre- and post-logging home range size. The experimental animal (#34) relocated from one part of the experimental zone to another before logging activities began; the new home range was 25% smaller than the old. The two controls (#'s 28 and 42) showed an increase of 100 per cent and decrease of 13% (respectively) in home range size (Table 13). The increase in #28's home range consisted almost entirely of annexed experimental area.

Bissonette *et al.* (1988) found that marten use of clear-cuts was limited; kits were located in clear-cuts 11.5% of the time, older marten 2.2% of the time. However, these figures do not include the frequent use by marten of the cut area around the researchers' camp. The animals were attracted to the camp area by the availability of food scraps.

Dispersal

Dispersal is defined as a permanent move from the natal home range (Bisonnette *et al.* 1988). Transient marten encountered in this study were less than two years old and probably in the process of dispersing. Kits left their natal home range from September through December. All known kits born on the study area either dispersed or died during their first fall. Establishment of a permanent home range began in the second year of life for marten # 42, # 46, # 49, but apparently began at six months of age or earlier for #32. She was a kit when first captured in November 1985 and maintained fidelity to her home range. No marten older than two years were encountered as transients or dispersees. The fate of most dispersees encountered is not known.

Long distance dispersal was documented for five animals in this study. Marten #31 and #30, both born in 1984, were captured and fitted with radio collars on the study area in November 1985. Male #31 was found in Barachois Pond Provincial Park on March 12, 1986, and just outside the park on March 18, 1986. This is a straight line distance of 40 kilometres from his original capture site. Male #30 was found at the junction of highway 47 to Stephenville and the Trans-Canada Highway on March 18, 1986. On June 16, 1986, he was found near Gallants Hill, also a straight line distance of 40 kilometres. Marten #50 left the study area in October 1986. In February 1987, he was captured accidentally near the Buchans power line corridor on the east side of Grand Lake, a straight line distance of 34 kilometres. Marten #62 was first captured on the study area November 1, 1986; he probably left the study area for good in December 1986. In November 1987, he was accidentally captured near Big Gull Pond just east of the Trans-Canada Highway near Georges Lake. This is a straight line distance of 24 kilometres, although he had to go around Grand Lake to reach this area. Marten #68 was first captured on the study area May 23, 1987. In January 1988, she was accidentally trapped near Gallants Hill.

Age-related demographics

Kits that were trapped usually left the area as transients, while yearlings were more likely to remain and colonize an area. One of 16 kits captured (#32) managed to establish a permanent home range on the study area during her first year. At least five (#'s 28, 32, 42, 46, and 49) of ten yearlings established permanent home ranges during their first two years of life. Female marten in Newfoundland probably first breed successfully during their third summer and produce their first litter when they are three years old. No yearling females encountered produced a litter.

Age ratios

Throughout most of the study, adults and yearlings were found on the study area in a 1:1 ratio (Table 14). The exception was during summer 1987 when we could document the presence of no yearling residents. The high mortality during the previous fall and winter (see below), as well as the possibly disruptive effects of road building and logging operations the previous year from June to November, may have had some effect. However, one marten (#69), appeared to be colonizing part of the study area during late summer and fall 1987. At no time during the study did adult females occupy all the available habitat on the study area.

Sex ratios

Sex ratios were not significantly different from 1:1 for all age classes throughout the study. From November 1985 through August 1987, 20 males and 20 females were captured on the study area;

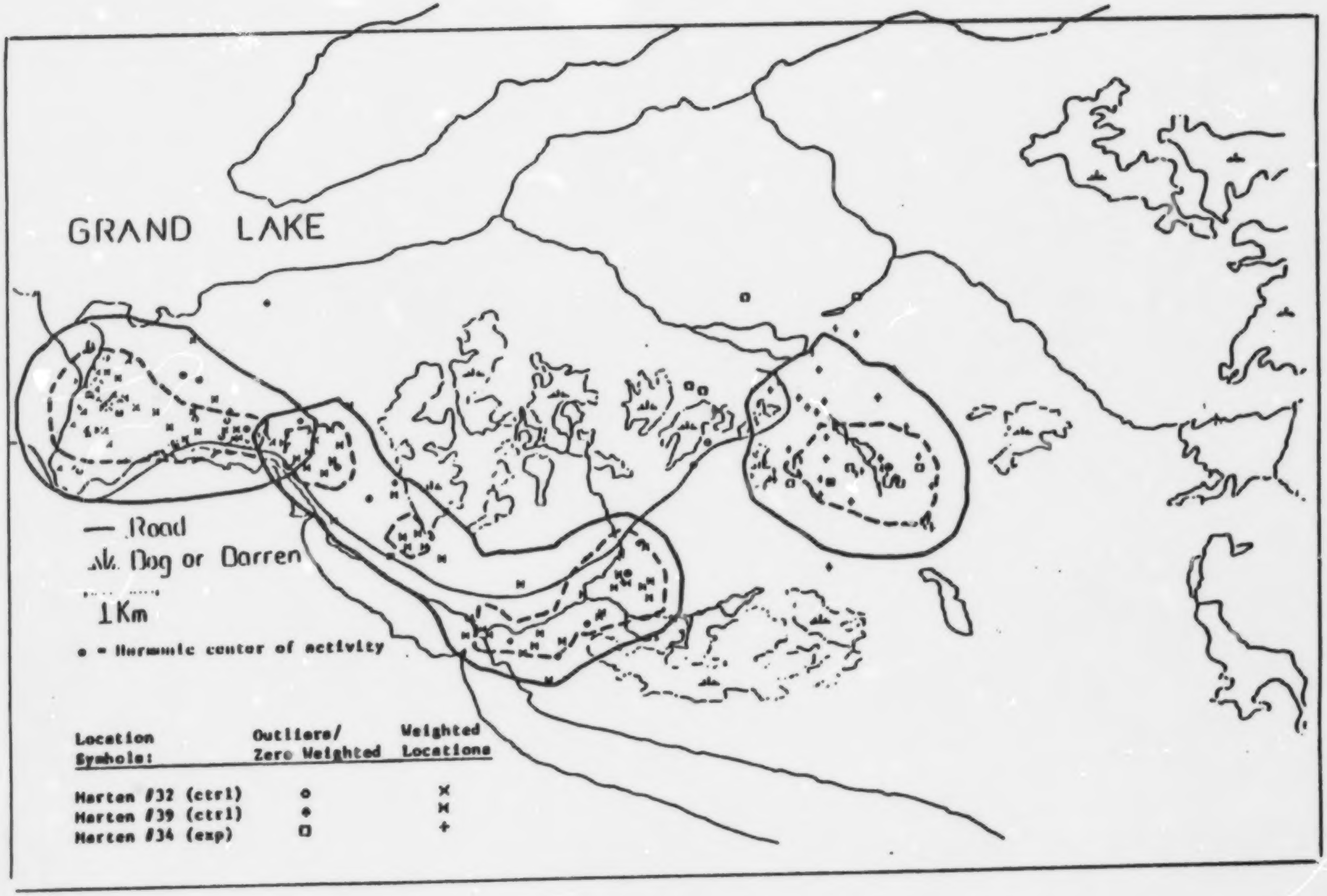

GRAND LAKE
— Road
Bog or Barren
1 Km
• = Harmonic center of activity
Location Symbols:
Outliers/ Zero Weighted
Weighted Locations
Marten #32 (ctrl) ○ ×
Marten #39 (ctrl) ◆ ⌘
Marten #34 (exp) □ +

Figure 17

Home ranges (solid lines), core areas (Broken lines), and outlier locations for female marten 32, 39, and 34 before logging. (Source: Bissonette et al.)

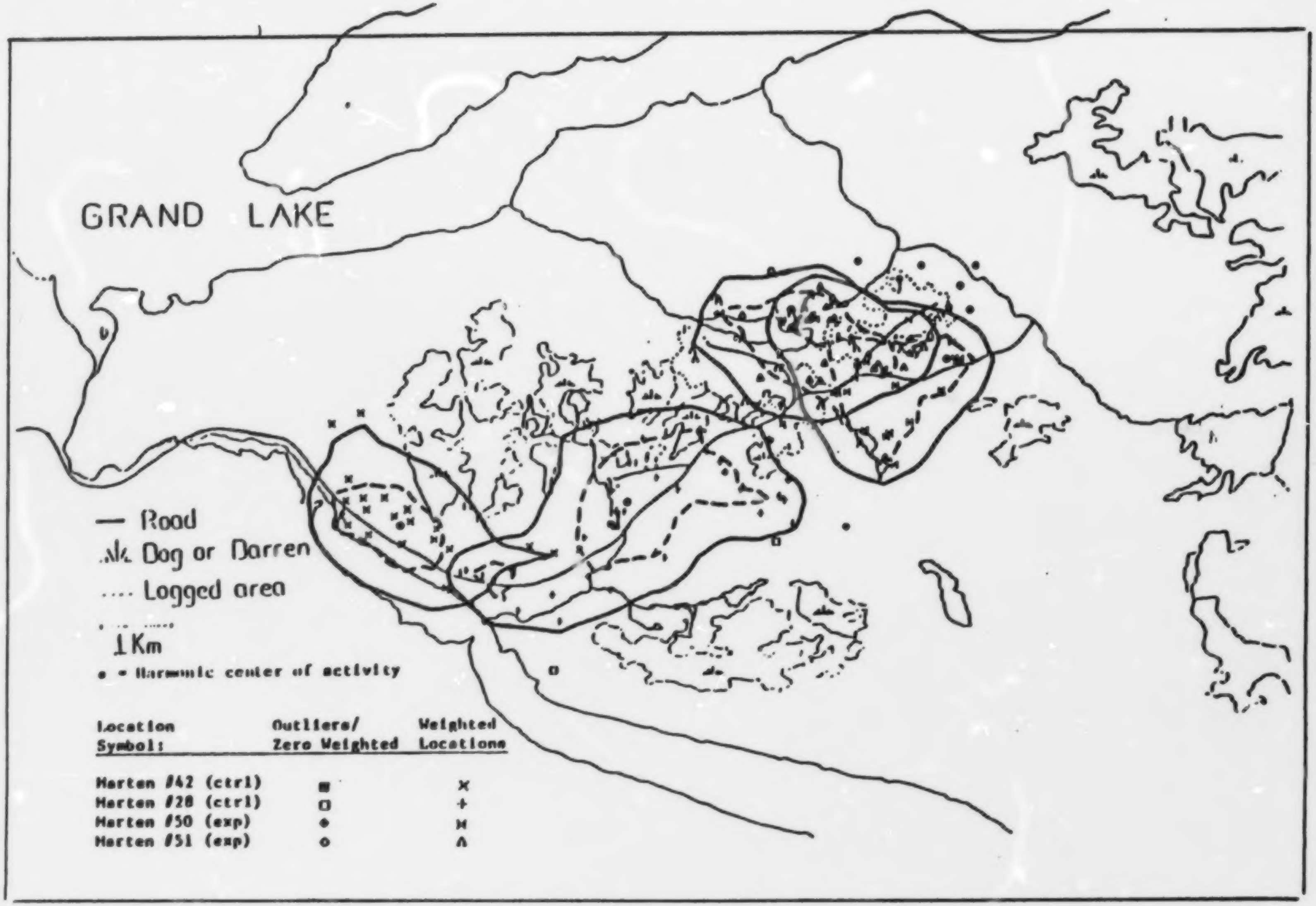

GRAND LAKE
— Road
.ılk Bog or Barren
.... Logged area
1 Km
● = Harmonic center of activity
Location Symbol:
Outliers/ Zero Weighted
Weighted Locations
Marten #42 (ctrl) ■ ×
Marten #28 (ctrl) □ +
Marten #50 (exp) ◆ ⌘
Marten #51 (exp) ○ ∧

Figure 18

Home Ranges (solid lines), core areas (broken lines), and outlier locations for male marten 42, 28, 50, and 51 during logging. (Source: Bissonette et al.)

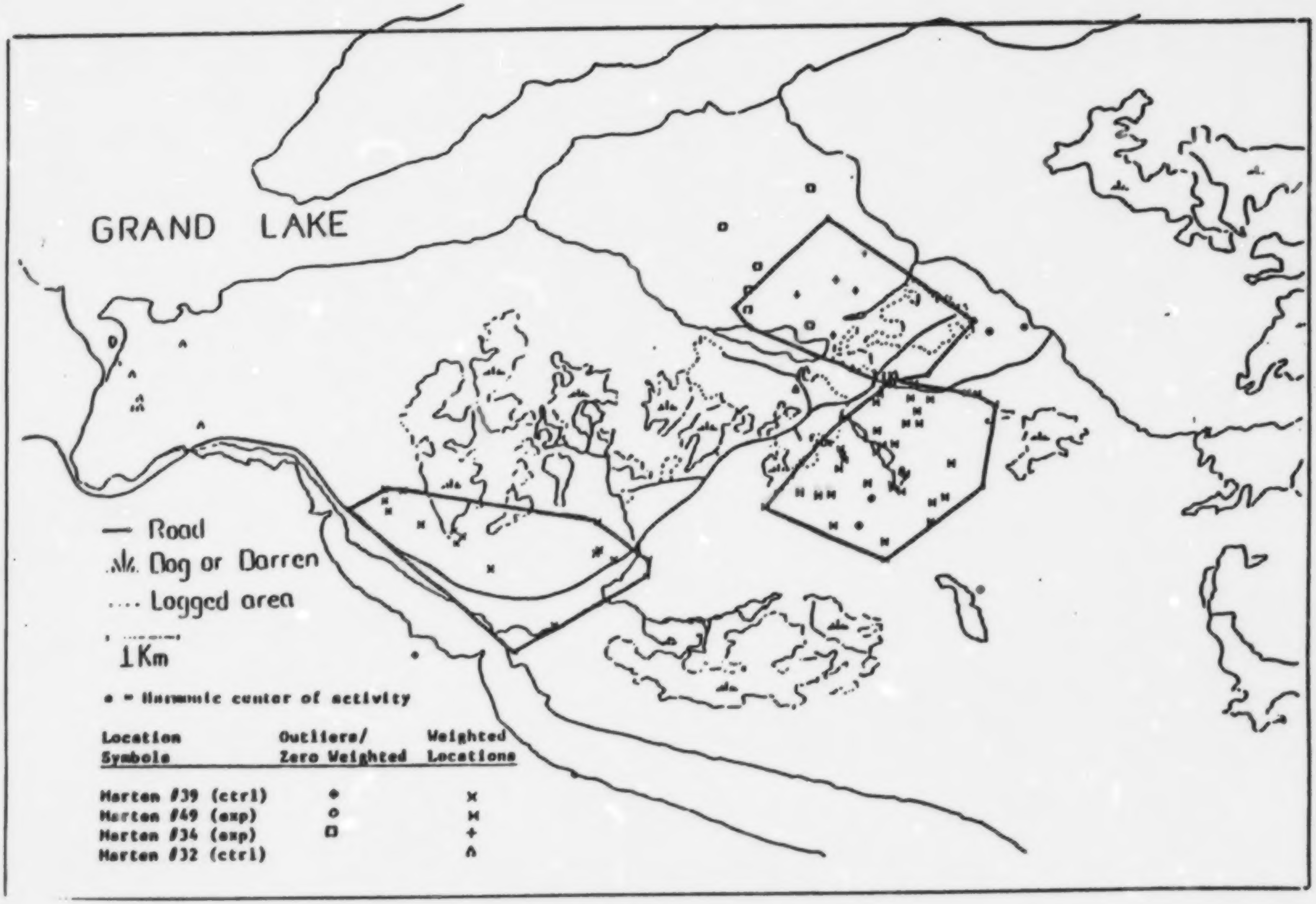

GRAND LAKE
— Road
Bog or Barren
.... Logged area
1Km
• = Harmonic center of activity
Location Symbols
Outliers/ Zero Weighted
Weighted Locations
Marten #39 (ctrl)
Marten #49 (exp)
Marten #34 (exp)
Marten #32 (ctrl)

Figure 19

Home ranges (solid lines), and outlier locations for female marten 39, 49, and 34 and locations for female marten 32 during logging. (Source: Bissonette et al., 1988)

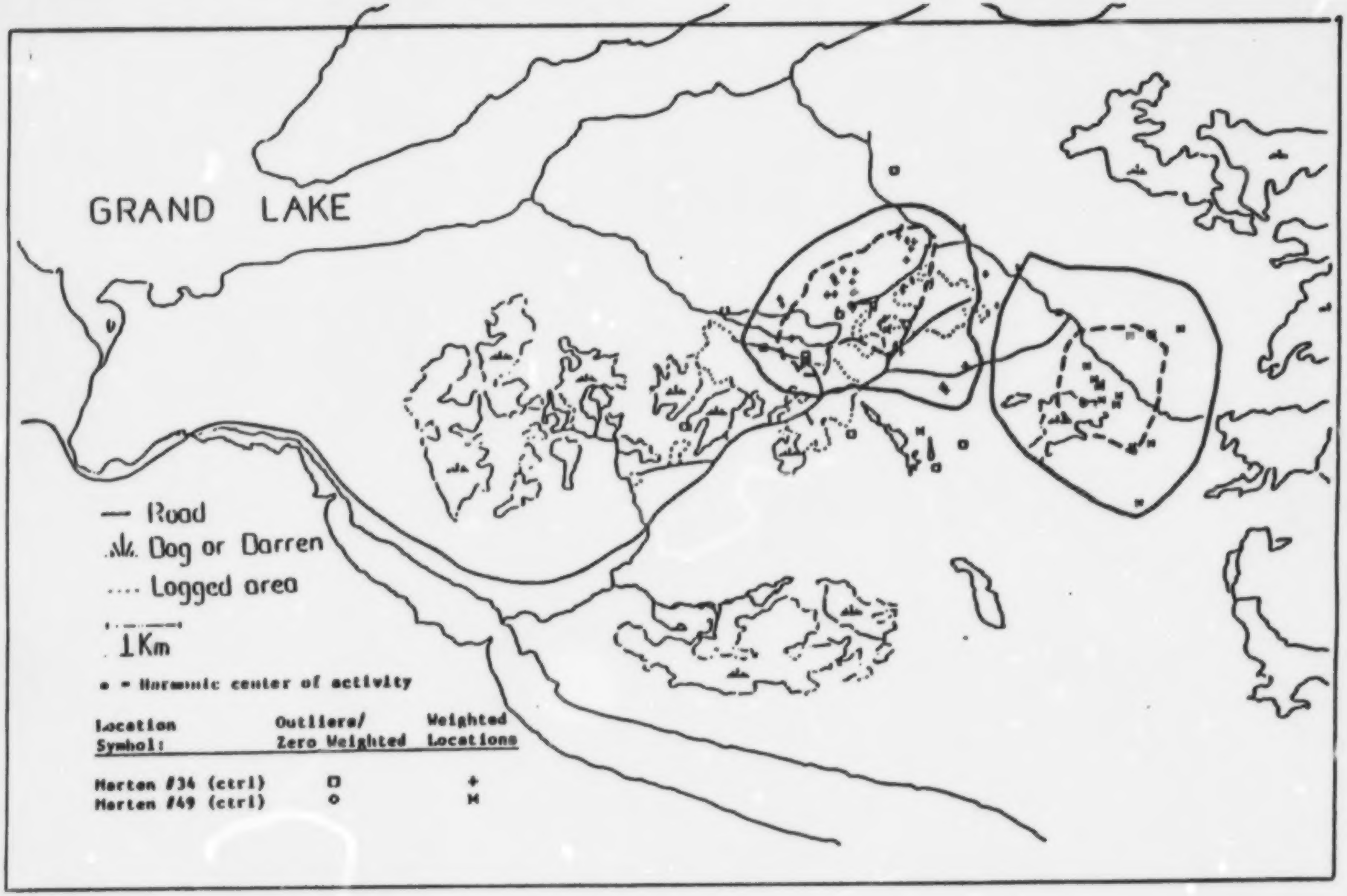

GRAND LAKE
— Road
Bog or Barren
.... Logged area
1 Km
• = Harmonic center of activity
Location Symbol:
Outliers/ Zero Weighted
Weighted Locations
Marten #34 (ctrl) □ +
Marten #49 (ctrl) ○ x

Figure 20

Home ranges (solid lines), core areas (broken lines), and outlier locations for female marten 34 and 49 after logging. (Source: Bissonette et al., 1988)

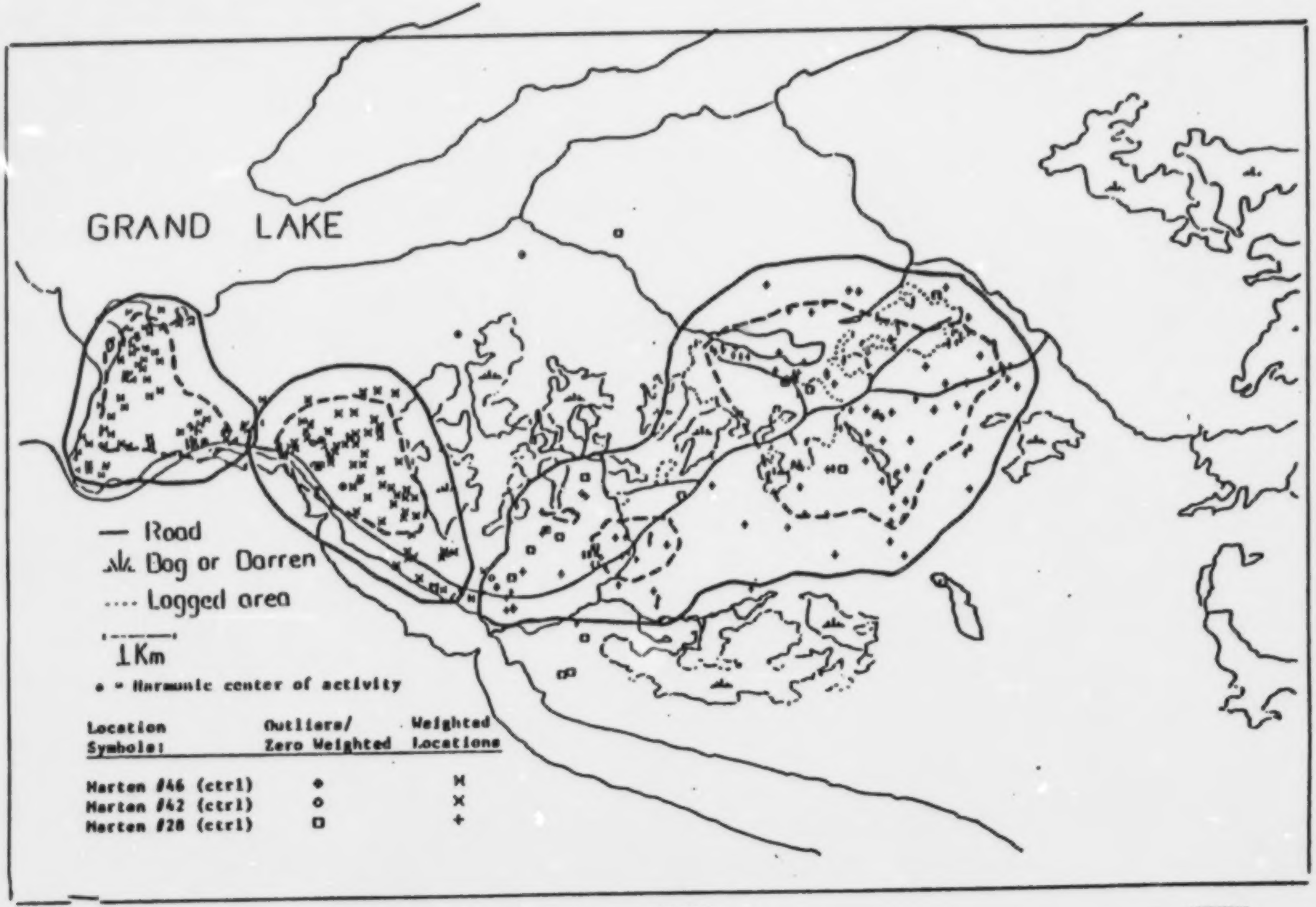

GRAND LAKE
— Road
Bog or Barren
.... Logged area
1 Km
• = Harmonic center of activity
Location Symbols:
Outliers/ Zero Weighted
Weighted Locations
Marten #46 (ctrl) ◆ ⌘
Marten #42 (ctrl) ○ ×
Marten #28 (ctrl) □ +

Figure 21

Home ranges (solid lines), core areas (broken lines), and outlier locations for male marten 46, 42, and 28 after logging. (Source: Bissonette et al., 1988)

Minimum convex polygon and harmonic mean estimates (see Bisonnette et al. 1988, Appendix I for description) of home range and core area size, before, during, and after logging at Little Grand Lake.

	Before	During 1	After 2	
#34	6.14[2] (93)[3]	—	4.59 (62)	1.87[4]
	1.87[4]	—	1.77	
	4.93[5] (75)	3.19	3.53 (47)	
#49	—	6.84 (47)	7.81 (30)	
	—	2.35	1.71	
	—	4.21 (42)	8.33 (23)	
#39	8.22 (59)	—	—	
	3.00	—	—	
	8.31 (46)	4.34 (18)	—	
#32	5.34 (88)	—	—	
	2.45	—	—	
	4.24 (67)	—	—	
#28	9.24 (63)	7.96 (44)	18.81 (169)	
	3.82	2.60	6.24	
	8.45 (52)	6.96 (40)	17.11 (135)	
#29	13.16 (83)	—	—	
	5.38	—	—	
	9.88 (50)	—	—	
#50	—	4.57 (35)	—	
	—	2.05	—	
	—	3.75 (30)	—	
#51	—	2.88 (61)	—	
	—	1.18	—	
	—	1.96 (48)	—	
#42	5.18 (64)	2.91 (31)	4.53 (96)	
	2.20	1.16	2.24	
	4.26 (46)	3.08 (29)	3.65 (76)	
#46	—	—	4.01 (96)	
	—	—	2.13	
	—	—	3.58 (91)	

[1] Clear-cut areas were subtracted from these home range estimates.

[2] 95% harmonic mean home range size in km^2.

[3] Number of relocations used in home range estimation.

[4] Harmonic core area size in km^2.

[5] 100% minimum convex polygon home range size in km^2.

Table 13

Age and sex ratios of marten at Little Grand Lake

Season	<year	1-2 years	>2 years	Unknown	Total
Winter 1986					
all captured[1]	3(0/3)[2]	4(4/0)	4(2/2)	3(2/1)	14(8/6)
residents	2(0/2)	1(1/0)	3(1/2)	—	6(2/4)
Summer 1986					
all captured	4(3/1)	5(2/3)	5(3/2)	1(0/1)	15(8/7)
residents	4(3/1)	5(2/3)	4(2/2)	—	13(7/6)
Fall 1986					
all captured	13(6/7)	5(2/3)	5(2/3)	2(2/0)[3]	25(13/12)
residents	0	5(2/3)	5(3/2)	—	10(5/5)
Winter 1987					
all captured	2(0/2)	3(2/1)	2(1/1)	—	7(3/4)
residents	0	3(2/1)	2(1/1)	—	5(3/2)
Summer 1987					
all captured 0	2(1/1)	3(3/0)	2(0/2)[4]	7(4/3)	
residents 0	0	3(3/0)	—	3(3/0)	

1 Includes marten captured in November 1985.
2 Males/females.
3 Age confimation for one of these animals is pending.
4 Age of confirmation for these animals is pending. All are believed to have been born in 1986.

(Source:Bissonette *et al.* 1988)

Table 14

16 males and 15 females were captured on the study area in 1986, while 4 males and 7 females were captured in 1987, with some individuals captured in more than one year. The skewed sex ratio of 1987 may have resulted from the total absence of resident females during summer 1987, allowing more transient females to use the area. Sex ratios remained mostly constant at 1:1 for each age class through most seasons except summer 1987, and for all classes combined (Table 14). By the spring of 1987, no females could be found on the study area. All females resident in 1986 either died or disappeared by spring.

Productivity

Two female marten (#34 and #39) produced litters on the study area in 1986; no female marten were

Mortality factors and numbers of deaths by age and sex class for marten at Little Grand Lake

Mortality			Age		
Factor	Kits	Yearlings	Adults	Unknown	Total
Disease	5(1/4)[1]	1(0/1)	3(2/1)	1(1/0)	10(4/6)
Predation	1(0/1)	-	1(0/1)	1(1/0)[2]	3(1/2)
Handling related	2(0/2)	-	-	-	2(0/2)
Dispersed, accidentally trapped[3]	1(1/0)	-	-	-	1(1/0)
Died, cause unknown	1(0/1)	-	-	-	1(0/1)
Suspected	—	-	-	2(2/0)	2(2/0)
Totals[4]	**10(2/8)[4]**	**2(1/1)**	**4(2/2)**	**2(2/0)**	**17(6/11)**

1 Males/females.

2 Suspected to be a kit.

3 Two additional marten, #62 and #68, were accidentally trapped after this study ended.

4 Does not include suspected deaths.

(Source: Bissonette *et al.* 1988.)

Table 15

known to produce litters on the study area in 1987. Female #34 produced at least two kits in 1986 (#50 and #51) and possibly a third, #52. Only two kits (#48 and #53) were captured within the home range of female #39. An intensive effort was made to capture kits on the study area once they became independent of their mothers in July. It was thought that all kits produced by females #34 and #39 in 1986, and survived until independence, were captured. If this is true, female # 34 may have produced three kits, while female #39 produced two in 1986. Female #34 was five years old in 1986; female # 39 was four years old. Two yearling females (#32 and #49) residing on the study area during the summer of 1986 did not produce kits. During 1987, it appeared there were no reproductively active adult females available for mating during the summer breeding season.

Mortality

Marten deaths during the study were attributable to at least four factors. Disease, predation, accidental trapping, and handling were the causes of 16 of the 17 marten deaths on the study area. Two others may have died, but we were unable to confirm their status. Table 15 lists the numbers, ages and sexes of those dying by each factor. Table 16 lists the individuals that died. In addition, one marten (#57) outside the study area died from disease. Each factor is discussed below.

Disease

The most significant mortality factor encountered during the study was a disease outbreak in fall 1986. Post-mortem and lab analysis of tissue samples for six animals resulted in a tentative diagnosis of viral non-supportive encephalitis. The first suspected disease death occurred September 19, 1986; the last recorded, November 1, 1986. Ten marten are suspected of dying of encephalitis. Marten of all age and sex classes died (Table 15) including five kits, one yearling, three adults, and one marten of unknown age. The sex ratio of those dying on the study area was four males to six females. Proportionally, approximately equal numbers of deaths were noticed among adults and kits, but fewer among yearlings. One of five known yearlings captured on the study area died, while

Cause of death of individual marten inside and outside study area

LITTLE GRAND LAKE STUDY AREA	Number	Individuals
Disease	10	LGL29, 35, 39, 43, 48, 56, 58, 59, 60, 61
Predation	3	LGL34, 65, 66
Handling related deaths	2	LGL63, 67
Dispersed, accidentally trapped	1	LGL50
Died, cause unknown	1	LGL36
Fate unknown	15	LGL30, 31, 32, 33, 37[1], 38, 40[1], 41, 45, 49, 51, 52, 53, 55, 64
Alive at end of study	8	LGL28, 42, 46, 62[2], 68[3], 69, 70, 71
OUTSIDE THE STUDY AREA		
Disease	1	LGL57
Fate unknown	4	LGL13, 44, 47, 54

[1] Unconfirmed death.

[2] Accidentally trapped 11/87 near Big Gull Pond.

[3] Accidentally trapped 1/88 near Gallants Hill.

(Source:Bissonette *et al.* 1988)

Table 16

three of five known adults and five of eleven kits died. Two other kits were captured during this time, but were not radio collared; their fates are unknown.

Predation

Predation upon marten resulted in three deaths on the study area during fall 1986 and winter 1987. Marten # 65 was captured and radio collared December 4, 1986. He was probably killed and appeared to have been consumed by a raptor or raven on either December 5 or 6. His radio collar and a tuft of fur were found on a limb 20 feet high in a tree 2.3 km from the capture site. Marten #66 was first captured January 29, 1987. On February 11, 1987, her radio collar was found; it appeared that she had been consumed by a red fox (*Vulpes*). Marten #34 was found dead in a subnivean cavity on March 31, 1987. Post-mortem examination revealed internal organ damage and haemorrhaging caused by physical trauma, indicating she may have escaped a predator only to die later from her injuries. No animal tracks were seen in the area.

In addition to these incidents, a failed predation attempt by a hawk owl (*Surnia ulula*) was witnessed November 1, 1986. The owl made three passes at marten #32 while she was in a tree. On the third pass, she fell ten feet to the ground and immediately darted into a nearby hole, apparently uninjured.

Handling-related deaths

Two marten deaths apparently were handling related. Female #63 was first captured and radio collared November 5, 1986. She was found dead in a cavity beneath a tree stump November 29, 1986. Her radio collar had slipped over her shoulders and had pinned the upper portion of her front legs to her body, making normal walking impossible. She appeared to have died from starvation. Marten #67 was first captured March 13, 1987; she died March 15, 1987 from a combination of chronic starvation and hypothermia. When encountered in a trap the morning of March 15, she was partially wet; the previous night's temperature did not get below freezing. At her first capture on March 13, she weighed 625 grams, a very low weight for a female marten. At her death she weighed 550 grams. During these three days she was captured four times. Her behaviour when released from the traps indicated she probably was starving. Additional food was twice left for her upon release to ensure she did not become a trap mortality. It is very possible she would have died before the onset of spring.

Accidental captures

Marten #50, a kit, was accidentally trapped in February, 1987 near the Buchans power line corridor on the east side of Grand Lake, approximately 34 km northeast of his maternal range. Though he was captured in a live trap, he was dead when encountered by the trapper. He dispersed from the study area in October, 1986. Marten #62 was accidentally trapped in November 1987 near Big Gull Pond approximately 24 km west of the study area. Marten #68 was accidentally trapped near Gallants Hill in January 1988, approximately 31 km west of the study area. The latter two mortalities were not included in subsequent calculations since the deaths occurred after our study ended. These are the only known instances study animals being accidentally trapped, though several marten are usually captured each season outside the "no trapping" area. All three known accidental captures were outside the PMSA.

Unknown causes

Female # 36 was captured and radio collared January 23, 1986. She is believed to have died shortly afterward. The cause of death is unknown.

In addition to these deaths, two other marten may have died. A mortality signal was picked up for marten #40, but we were unable to recover either the radio collar or carcass. Marten #37 was captured and collared January 23, 1986. He was last located in February, 1986. His fate is unknown.

Seventeen of 40, or 42.5 per cent, of the marten captured on the study area between November 1985 and August 1987 died by the end of the study in August 1987. Twenty per cent (8 of 40) were known to be alive at the end of the study, while the fates of 37.5 per cent (15 of 40) were unknown. Disease contributed 59 per cent of the known mortality (10 of 17 deaths); handling accounted for 11.5 per cent (3 of 17 deaths), while accidental capture and death of unknown cause each contributed six per cent for a total of 2 of 17 deaths. A 42.5 per cent mortality over 22 months yields a minimum average annual mortality rate estimate of 0.232 for the entire population.

The fates of 25 marten captured on the study area are known; 17 died and 8 were alive at the end of the study. Fifteen of 23, or 65 percent, died of natural causes (all factors except handling) during the course of the study. If the marten whose fates are unknown (n=15) experienced similar mortality, then 65 percent of all marten captured on the study area died by the end of the study; 43 per cent died from encephalitis during fall 1986. This yields and average annual mortality rate estimate of 0.356 for the entire population.

3.6.2 Big Game

Moose (*Alces alces*) and caribou (*Rangifer tarandus*) are the major big game species in the study area. The mature and overmature timber represents good wintering habitat for moose, but is not very suitable for the rest of the year. For this reason, as well as because of the expanding amount of insect killed and damaged timber, moose numbers are not high in the study area. Fredrickson and Tucker (pers. comm.), who noted that there were some moose throughout the area, recorded two winter moose yards during the two year study of marten. The yard is located on the north bank of Lewaseechjeech Brook approximately 1 km downstream from Little Grand Lake at a point adjacent to the western boundary of the study area. The other yard is situated approximately 8-10 km east of Marten Pond (Figure 22).

The study area falls within Moose Management Zone number 11 (Dashwoods), which lies south of Little Grand Lake, and number 12 (Buchans) which lies north of the lake (Figure 23). Based on the population estimates produced by Strapp and Mercer (1975), the current moose populations in Zones 11 and 12 would be approximately 4,500 and 700 animals respectively. The population density in Zone 11 in 1975 was among the highest on the island (2.4 moose per square mile); density in Zone 12 was one of the lowest (0.3 moose per square mile). These relative densities apply today, and indicate that the major moose habitat in the region lies outside the study area.

The study area is not an important area for caribou. A few animals may be present throughout the year; scattered individuals or small groups are observed more frequently in summer than at any other season (Fredrickson and Tucker, 1987 pers. comm.). The herd affiliation of these caribou is not known, but they could be animals from a number of herds, particularly La Poile and Buchans (Russell, 1988, pers. comm.). The calving and post-calving range of the Buchans herd is in the vicinity of Star Lake, 30 km east of the study area. Animals remain on the plateau in this general region from late May to November. The main migration direction to winter range along the coast is south-west, passing south of the study area by 10-15 km. It is not unexpected that some Buchans animals would move through the study area during the migration to and from winter range, as well as filter into the study area while the herd is summering on the plateau. A few animals may even cross Little Grand Lake at a narrow section toward the west end.

During winter, caribou from several herds (Buchans, La Poile, Grey River and perhaps others) mix together along the coast. As the animals disperse to calving and summer range in the spring, mixed groups may continue together for some distance. Thus, it is likely that caribou from most of the regional herds will pass through the study area from time to time. But the study area represents neither important seasonal range nor critical migration routes for caribou.

3.6.3 Upland Game

Quantitive data on population levels of upland game in the study area are not available. However, interviews with Wildlife Division personnel did provide some general information.

The snowshoe hare (*Lepus americanus*) does not reach high numbers (even in cyclic peaks) in the study area because of the mature and overmature state of much of the forests. It is in cutovers and other areas supporting vegetation in the early stages of succession that the species reaches its highest densities (Dodds, 1960). At present the snowshoe hare will be most common around the spruce swamps that occur throughout the study area.

Willow ptarmigan (*Lagopus lagopus*), rock ptarmigan (*Lagopus mutus*), and ruffed grouse (*Bonasa umbellus*) are present (Fredrickson, pers. comm.), but numbers are not high because of the mature nature of much of the area's vegetation. As with snowshoe hare, these birds prefer locations where the early stages of vegetation are available. However, there are enough disturbed areas and barren uplands (spring and summer habitat), and forested river/tributary valleys (shelter in adverse weather) in the study area to support the modest numbers of birds that are present.

The early successional stages of vegetation that will result from clear cutting and road right-of-way clearing will provide a food base capable of supporting much larger populations of hares, ptarmigan and ruffed grouse. Given the right habitat, populations of upland game can build to very high numbers during periods of cyclic abundance.

3.6.4 Furbearers

All furbearers present on insular Newfoundland probably occur in the study area. River and stream banks, forests and forest edges represent the preferred habitat for most furbearers; such habitat can be found, in limited supply, in the study area. However, the modest prey base of small mammals and upland game available for predatory furbearers, together with the limited amount of suitable water habitat for aquatic furbearers, suggests that while all fur species might be present, numbers are not likely to be very high.

Fredrickson (pers. comm., 1987), who observed a number of foxes (*Vulpes vulpes*) and fox tracks in 1986-87, suggested that this species was probably the most abundant furbearer in the study area. Fredrickson also noted evidence of lynx (*Lynx canadensis*) but doubted that many were resident in the study area. Red squirrels (*Tamiasciurus hudsonicus*) were frequently observed throughout the area although not in great abundance (Bissonette *et al.*, 1988).

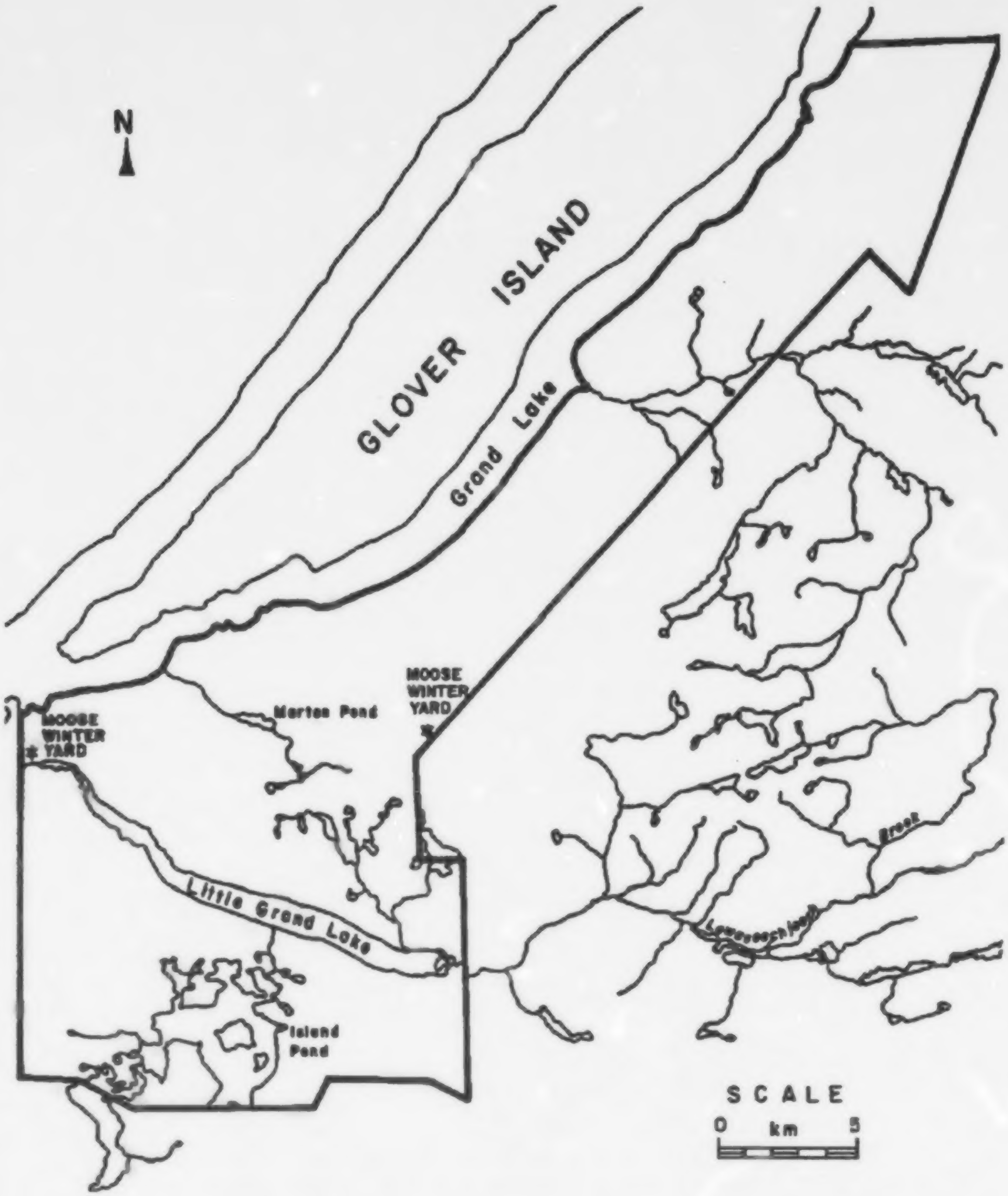

N
GLOVER ISLAND
Grand Lake
MOOSE WINTER YARD
Marten Pond
MOOSE WINTER YARD
Little Grand Lake
Island Pond
Brook
Lewaseechjeech
SCALE
0 km 5

Figure 22

Location of known moose yards in Little Grand Lake study area

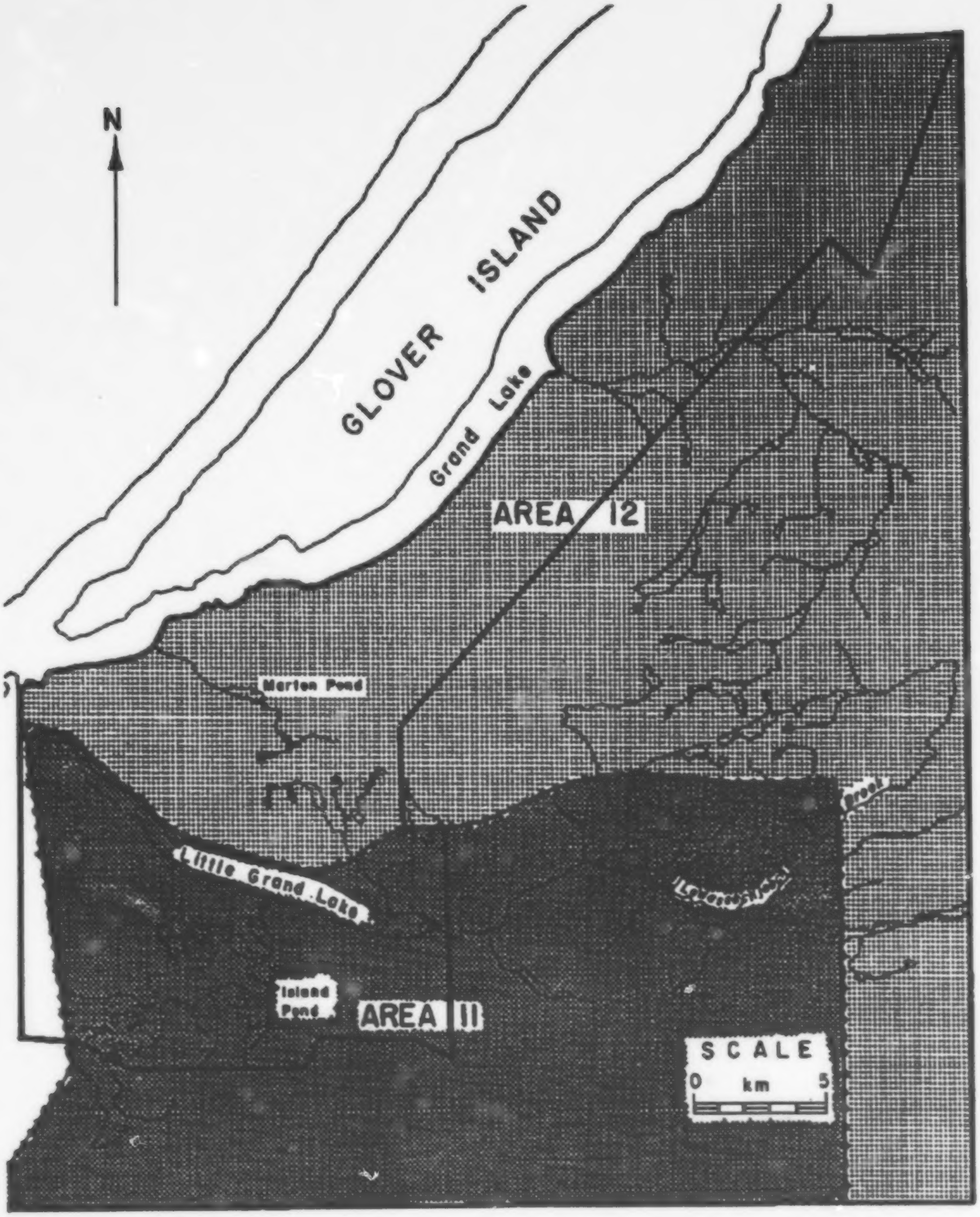

N
GLOVER ISLAND
Grand Lake
AREA 12
Morton Pond
Brook
Little Grand Lake
Island Pond
AREA 11
SCALE
0
km
5

Figure 23

Moose management zones in vicinity of Little Grand Lake study area

Data on other fur species in the study area are practically non-existent. Trapping is prohibited, so trapper returns are unavailable. However, it is likely that beaver (*Castor canadensis*), ermine (*Mustela erminea*) and otter (*Lutra canadensis*) are found there.

3.6.5 Raptors

Data on raptors in the study area are fragmentary. No systematic survey work has been carried out there, and the area's relative isolation has resulted in very few records by casual observers over the years. However, since 1982 the area has been fairly regularly occupied by various individuals carrying out studies on the pine marten. Some of these individuals, and a number of others with a good knowledge of raptors in western Newfoundland, were interviewed in order to consolidate as much information as possible on raptor presence in the study area. The following individuals provided information : J. Brazil, J. Campbell, R. Fredrickson, I. Goudie, J. Hancock, J. Lemon, J. Maunder, E. Menchenton, T. Northcott, F. Phillips, P. Ryan, W. Skinner, B. Tucker and G. Van Dusen.

Seven species of raptors and owls have been observed in the study area.

Rough-legged Hawk (Buteo lagopus)

Several individuals of this species have been observed in the study area, most recently in 1987 (Brazil, Fredrickson pers. comm.). This hawk probably breeds in the study area, and small numbers may overwinter.

This hawk favours habitat where escarpments, rocky outcrops, steep river banks, and ravines may be found. It feeds primarily on rodents and small birds. Nests are usually located on the tops or ledges of cliffs, on shelving rock, or near the tops of trees (trees which range from 6-9 m in height). Nests are used in successive years.

Bald Eagle (Haliaeetus leucocephalus)

There have been a number of observations of individual eagles flying in the study area, the most recent by Fredrickson (pers. comm.) in 1986. While no nests have been reported for the study area, it is quite likely that eagles do breed there, and possibly are year-round (or at least occasionally year-round) residents as well. Peters and Burleigh (1951) refer to this species as possibly occasional winter residents in Newfoundland, with the most common wintering area being along the south coast.

Eagles inhabit areas which include abundant water; larger lakes and rivers, the seacoast, and the countryside adjacent to these water bodies. The nest is usually constructed near the tops of trees; more rarely on cliff edges. Nests may be used for many years.

The eagle is probably more a scavenger than a predator. While it can catch fish, it more often feeds on fish found dead on the shore, and occasionally takes fish away from ospreys. Carrion is also a common food item for eagles.

Osprey (Pandion haliaetu)

This species has been frequently observed in the study area, particularly around Little Grand Lake. A nest containing two adults and young (number unknown) was observed by Northcott and Van Dusen on the north bank of Lewaseechjeech Brook just outside the west boundary of the study area on several occasions in the summer of 1988. This nest has been active for several years (Brazil, Fredrickson pers. comm.) and probably produced a total of six or eight young in the last four or five years. No nests have been reported inside the study area, but it is quite possible that one or more could exist there.

A more likely location for osprey nests is along Lewaseechjeech Brook just to the east of the study area. The Lewaseechjeech Brook — Little Grand Lake valley contains the mix of water, tall trees and cliffs that represent favourable osprey habitat. Ospreys feed principally on fish, and preferred nest sites are isolated trees (either dead or living) or cliff pinnacles. However, the modest fish population in the system (Section 3.5) suggests that two or three breeding pairs of ospreys may be the maximum number occupying the area.

Osprey are spring and summer residents, entering the area in April or early May and departing again in October or November.

Merlin (Falco columbarius)

The merlin has been observed in the area (Brazil pers. comm.), but sightings are few. It may be classed as a probable breeder in the study area, departing again in the fall.

The merlin nests in coniferous trees, frequently in abandoned nests of some other species such as crows. It feeds principally on other (usually smaller) birds.

Great Horned Owl (Bubo virginianus)

This largest and most common of Newfoundland owls has been observed in the study area, where it probably breeds and is a year-round resident. It usually nests in an abandoned hawk or crow nest, sometimes in a tree cavity. Nests are most often in deep woods.

The great horned owl feeds on a variety of prey including many species of birds and small mammals.

Hawk Owl (Surnia ulula)

There have been numerous observations of this owl in the study area and in south western Newfoundland generally. Fredrickson (pers. comm.) observed it quite frequently during his two year marten project. It undoubtedly breeds and resides year-round in the study area.

The hawk owl favours open conifer or mixed woodlands where it nests in hollow stumps, tree holes or deserted bird nests. This owl hunts in the daytime, and feeds on small mammals, young hares, and ptarmigan.

Boreal Owl (Aegolius funereus)

A boreal owl responded to tape-recorded calls in August, 1983, and is a suspected breeder and year-round resident in the study area (Brazil pers. comm.). This owl nests in either coniferous or deciduous trees, most often in natural tree cavities or in the abandoned nest of some other bird. It feeds chiefly on small rodents and insects, and occasionally on small birds (Peters and Burleigh, 1951).

Other Raptors

A number of other raptors are likely to occur in the study area even though they have not been reported there. These include northern goshawk (*Accipiter gentilis*), sharp-shinned Hawk (*Accipiter striatus*), and American kestrel (*Falco sparverius)*. Godfrey (1986) suggests that these species could be migrant breeders in western Newfoundland.

3.6.6 Waterfowl

No systematic survey work has been carried out for waterfowl in the study area or in adjacent areas of western Newfoundland. The brief description of the waterfowl resource presented here is based largely on information provided by the same individuals who were interviewed for data on raptors (Section 3.6.5).

The species reported to breed in, and be summer residents of, the study area are common loon (*Gavia immer*), Canada goose (*Branta canadensis*), green-winged teal (*Anas crecca*), black duck (*Anas rubripes*), ring-necked duck (*Aythya collaris*), common goldeneye (*Bucephola clangula*), common merganser (*Mergus merganser*), and red-breasted merganser (*Mergus serrator*).

Among these eight species, Canada goose and common goldeneye appear to be the most frequently observed waterfowl in the study area. Fredrickson (pers. comm., 1987) considers the common goldeneye to be the most numerous, while Menchenton and Tucker (pers. comm., 1987, 1988) report good numbers of Canada geese nesting on the uplands and staging in small flocks at the eastern end of Little Grand Lake. One goose nest and two goldeneye nests were recorded by Fredrickson (pers. comm.) in 1987 (Figure 24).

The study area lies within the Long Range Barrens ecoregion, one of the most unproductive habitats for waterfowl in Newfoundland (Goudie 1987). Based on Goudie's estimated breeding densities for "contributing" water (those parts of water bodies lying within 0.5 km of shore) in this ecoregion, it was calculated that the study area could theoretically support approximately 150 breeding pairs of waterfowl of five or six species. About 75% of this theoretical breeding population would be centered around Little Grand Lake and Island Pond in the southern part of the study area.

Waterfowl are generally present in the study area from April to October, with the three month period of nesting and broad rearing (May - August) being the period when the birds are most easily disturbed.

3.7 HISTORIC RESOURCES

3.7.1 Introduction

A Stage 1 Historical Resources Overview Assessment of the proposed timber harvesting area in the Little Grand Lake vicinity was conducted during September 1987. The study consisted of a literature search to determine the presence of known archaeological sites, interviews with persons familiar with the area for the same purpose, a helicopter reconnaissance of the entire area and ground testing and excavation in the area to be impacted directly and, to a lesser extent, in immediately adjacent areas.

The objectives and general scope of the Stage 1 study accord with those set forth by the Historic Resources Division, Department of Culture, Recreation and Youth, Government of Newfoundland and Labrador, dated June 23, 1982. As stated in that document the general objectives of the study were:

a) to identify and assess Historic Resources potential or sensitivity within the study area, and

b) to recommend the appropriate methodology and scope for detailed impact assessment studies in Stage 2.

Preliminary background research took place in early September 1987. Informant interviews and field reconnaissance were conducted primarily in mid-late September 14, 1987.

The study area is comprised of a number of large and small lakes and ponds surrounded by high mountainous land with steep, wooded slopes and bald summits. Streams are shallow, narrow and fast-moving, flow principally through steep-sided gorges. The lakes are shallow and in many cases practically devoid of fish resources. Wildlife officers familiar with the area report that the region is presently largely devoid of game species, except for caribou which are present during the annual migrations. Caribou are reported by the same authorities to cross Little Grand Lake at a narrow section near its western end, but testing of the reported crossing revealed no evidence of aboriginal or other occupation.

The level of Grand Lake has been raised approximately 30 feet to facilitate movement of logs resulting from previous cutting operations. This makes it unlikely that any archaeological sites remain unsubmerged along the shores of this body of water.

3.7.2 Methodology

The methodology employed in this historic resources assessment was consistent with the guidelines for a Stage 1 Historical Resources Overview Assessment as well as with standard archaeological practice. Published and unpublished records of previous archaeological explorations within, and adjacent to, the study area were consulted. Persons familiar with the area were consulted to determine whether any archaeological or other historic remains had gone undetected by past researchers or had come to light since previous work was completed.

A helicopter survey of the entire study area, including areas proposed for timber harvesting, proposed roads, etc. was conducted. Based upon the results of this survey, areas judgementally selected as having relatively high archaeological potential were subjected to ground survey, including inspection of natural exposures and excavation of shovel test pits. The helicopter survey made it possible to eliminate many areas from further consideration, particularly the steep shorelines of many of the waterbodies which frequently rise abruptly to elevations as great as 125 m above the lake surfaces.

3.7.3 Results

Background Research

As far as can be determined, the only use of the study area in recent times has been recreational. Remains of several hunting/ fishing camps were visible in, and adjacent to, the study area. Many of these are no longer used and are in disrepair but do not constitute an historic resource.

Prior to this period of recreational use, portions of the study area were apparently cut over by logging operations in the early part of this century. As mentioned above, the level of Grand Lake was raised during these operations to facilitate movement of logs, hence any archaeological sites below the 30 foot contour have long since been submerged.

As far as could be determined, no previous archaeological survey or other investigation has

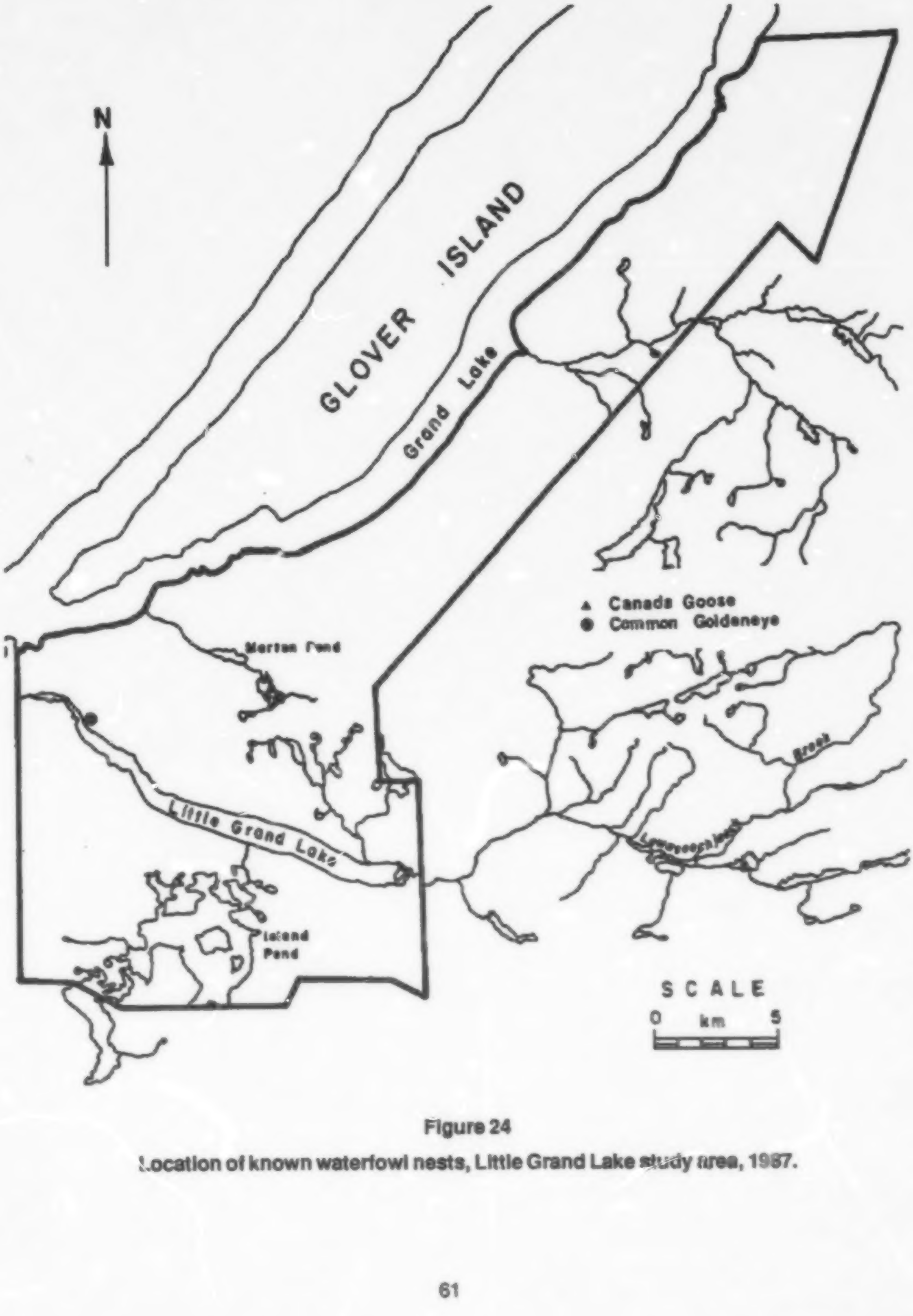

N
GLOVER ISLAND
Grand Lake
▲ Canada Goose
● Common Goldeneye
Morton Pond
Little Grand Lake
Island Pond
Brook
Lewaseechjeech
SCALE
0 km 5

Figure 24

Location of known waterfowl nests, Little Grand Lake study area, 1987.

been carried out in either the study area or in immediately adjacent regions. T.G.B. Lloyd, however, in a paper given before the Anthropological Institute of Great Britain in 1873 and 1874, lists a number of places on the Island of Newfoundland where aboriginal "implements" were found. Among these places are mentioned "... Grand Lake, Sandy Lake, Red Indian Lake etc" (Howley 1915). He does not specify where these finds were made, nor does he describe the implements. It is likely, however, that the find spot was near the shore of Grand Lake; if so the site is now drowned.

The most recent investigations geographically closest to the study area were those of Gerald Penney (personal communication) who conducted a brief reconnaissance in the interior some distance to the southwest of the study area. A small collection of Early or Middle Dorset material was recovered from secondary context on a small beach at Cross Pond, but no *in situ* remains were discovered. This material is supposed to have been reported in *Archaeology in Newfoundland and Labrador*, in one of the early volumes. The collection was also mentioned by David Simpson (n.d.) as an aside to his discussion of the archaeology of the Port au Port region.

In short, no sites were reported by informants and none is known through previous archaeological work. Studies of site files in the Newfoundland Museum and a search of standard references (e.g. Howley, 1915) also revealed no evidence of aboriginal presence in the study area.

Preliminary Field Reconnaissance

The initial stage of the field reconnaissance consisted of a helicopter overflight, at low altitude and at slow speed, to provide an initial assessment of the archaeological potential of the general area and to note locations for ground survey and testing. As a result of this initial assessment the following areas (Figure 25) were more thoroughly investigated:

Red Indian Brook (Area 1 on Figure 25)

Red Indian Brook flows from a high plateau through bog and scrub timber, then falls sharply into Grand Lake. It is a shallow stream which is not navigable and the shorelines have no areas which would afford suitable locations for campsites. The entire course of the brook appears to be of low archaeological potential. The shoreline at the mouth of the brook was test pitted and stream banks inspected, but neither produced any evidence of human utilization.

Area 2 (Figure 25)

Test pits were dug along the banks of an unnamed stream which looked promising both from the air and on the ground. Particular attention was paid to a mountain meadow ringed by thick timber which afforded excellent protection from weather. Fresh signs of game were noted. Despite the appealing nature of this location, test pitting did not reveal any evidence of human activity.

Area 3 (Figure 25)

This is a section of Little Grand Lake described by wildlife officers as a caribou crossing. It consists of a "narrows" formed by spits of land projecting from opposite sides of the lake. The beaches are active storm beaches and the sand of which they are comprised is subject to considerable shifting. It is likely that any archaeological sites which might once have existed in this area would have been destroyed by wave action. In any case inspection of the surface and test pitting failed to produce any cultural remains. This area is not subject to direct impact from timber harvesting activities.

Area 4 (Figure 25)

This is the delta region at the eastern end of Little Grand Lake. It is not endangered by timber cutting or ancillary activity, hence little time was spent in exploring the area. All cut banks were inspected for traces of archaeological remains with entirely negative results. A United States Armed Forces hunting lodge, now abandoned and in a dilapidated condition, is located on this delta but it was not considered of archaeological significance.

Area 5 (Figure 25)

This area is accessible only by helicopter. It is a small clearing near the headwaters of Bottom Brook which offers a protected camping location as well as a vantage point overlooking the lake. Test pitting produced no trace of archaeological remains.

Area 6 (Figure 25)

The southwestern limit of Little Grand Lake appears to provide excellent conditions for the location of archaeological sites. The shoreline has good, and apparently more or less stable, beach front conditions. Caribou tracks were observed on the beach. Test pitting along the shoreline in both directions from the outflow of the brook did not produce any evidence of human activity.

Among the alders and low scrub vegetation on a small sand and gravel spit four low rock mounds, obviously of human origin were discovered. They measure approximately 1.5 m by 2.0 m in maximum dimensions and are oval to sub-rectangular in form. The rocks which comprise the mounds range in size from fist-size cobbles to small boulders. Three of the mounds are parallel to the north - south axis of the sand and gravel spit and are roughly 2.5 m apart. The fourth is located approximately 2.0 m to the east of the central mound. All mounds were photographed (Figure 26) and the southernmost one dismantled (Figure 27). No cultural material was contained within the rock mound and excavation beneath the mound to a depth of approximately 60 cm revealed only undisturbed sand and fine gravel containing no trace of cultural remains. It was impossible, therefore, to determine the precise cultural origins of these features, although they are doubtless of human origin. The area shows no evidence of habitation or other use, hence it seems doubtful that the mounds resulted from clearing ground for planting, as might have occurred at woods camps. It is conceivable that they may be the last remaining portions of a "caribou fence" but a traverse inland showed no trace of additional mounds or other features which might suggest the presence of remains of such a structure.

This area is not threatened by the proposed timber harvesting and no further investigation is recommended.

Area 7 (Outside Study Area - Figure 25)

This area is a protected location on a small pond near a small unnamed brook which affords a good view of the surrounding area. Elsewhere in the country such areas were occasionally used as lookouts for game. This does not appear to have been the case at Area 7. However, timber harvesting operations had disturbed the ground surface and any evidence of earlier human activity would have been difficult to see.

Area 8 (Outside Study Area - Figure 25)

Mouth of Grand Lake or Lewaseechjeech Brook. This is a stretch of shoreline at the mouth of Grand Lake Brook on Grand Lake. The water level of Grand Lake was approximately 2.0 m below normal at the time of the survey and a wide beach was exposed. The brook flows into a sheltered cove at this point and the protected shoreline might have afforded an excellent camping place for parties travelling between the two lakes. The exposed beaches, cut banks, and test pits did not reveal any cultural remains except for garbage and campfires of very recent vintage. None of this material was found beneath the surface.

It should be remembered that even with a -2.0 m water level, the original shoreline of Grand Lake still lies ± 8.0 m below modern water level. It is likely that any sites which might once have existed around Grand Lake are now flooded.

Area 9 (Figure 25)

This is a wide river terrace about halfway between Grand Lake and Little Grand Lake. Test pits did not reveal any cultural remains in an unusual soil profile consisting of up to 60 cm of thick black organic soil or forest duff, the origin of which could not be determined.

Summary

Except for the four enigmatic rock mounds and some very recent garbage, no archaeological remains were found in the areas surveyed. The remains discovered (i.e. the rock mounds) are in an area not impacted by the proposed timber harvesting. Most of the areas tested did not present the obstacles to archaeological reconnaissance often noted in the boreal forest. That is, areas were more or less open, dense vegetation and roots did not prevent inspection of the surface and subsurface testing. It can be concluded, therefore, that the absence of archaeological sites reflects minimal, if any, use of the area in prehistoric or early historic times.

3.7.4 Evaluation and Discussion

The evaluation and discussion of the Historic Resources Impact Assessment Overview of the

Figure 25

Location of ground survey and test pits, historic resources survey of Little Grand Lake study area, September, 1988

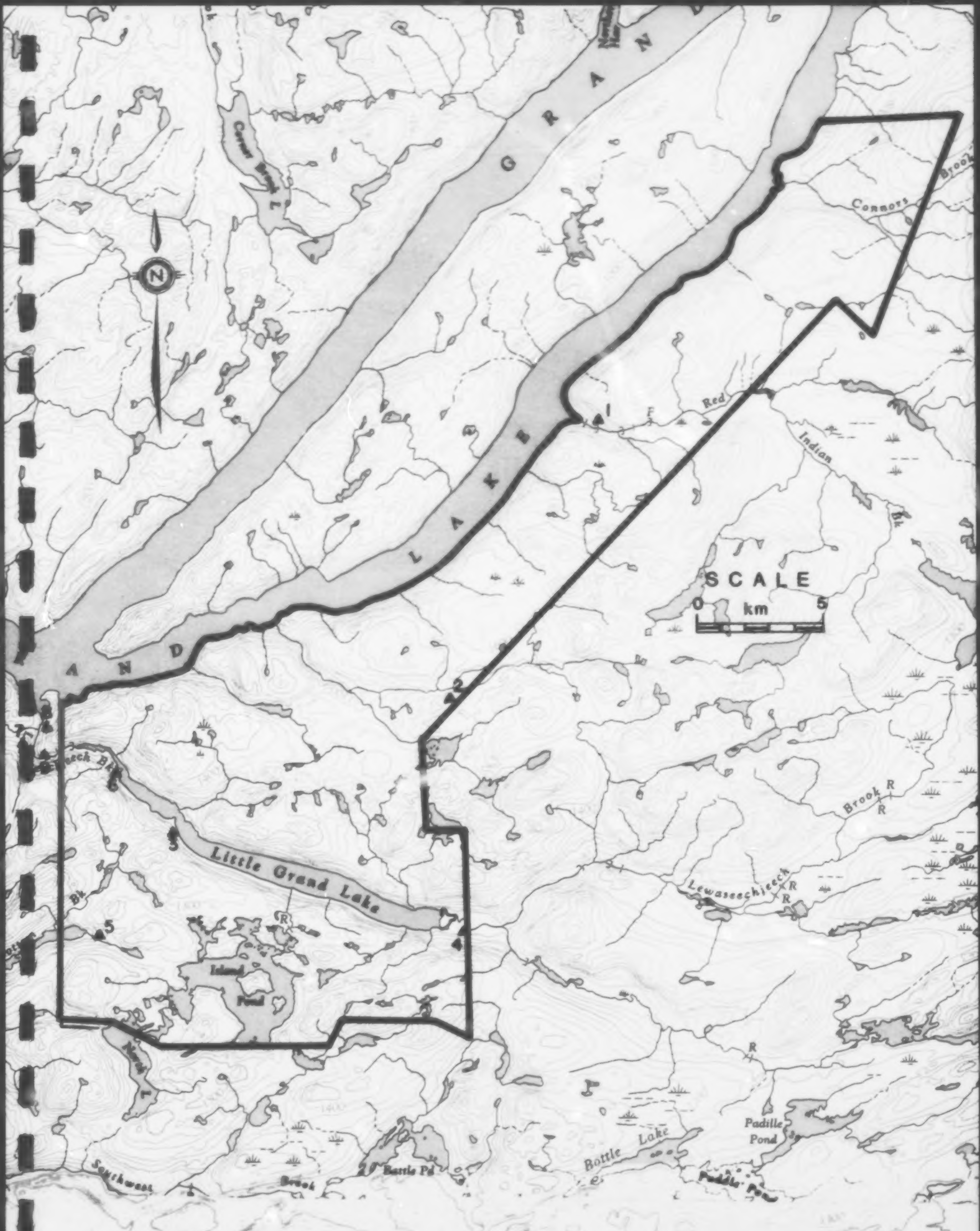

GRAND LAKE
Corner Brook L
N
Connors Brook
Red Indian Bk
SCALE
0 km 5
1
2
3
4
5
6
7
8
Little Grand Lake
Island Pond
Bk
R
Lewaseechjeech
Brook
Padille Pond
Bottle Lake
Battle Pd
Southwest Brook
Padille Pond

Figure 26

Close-up of rock mound at Little Grand Lake

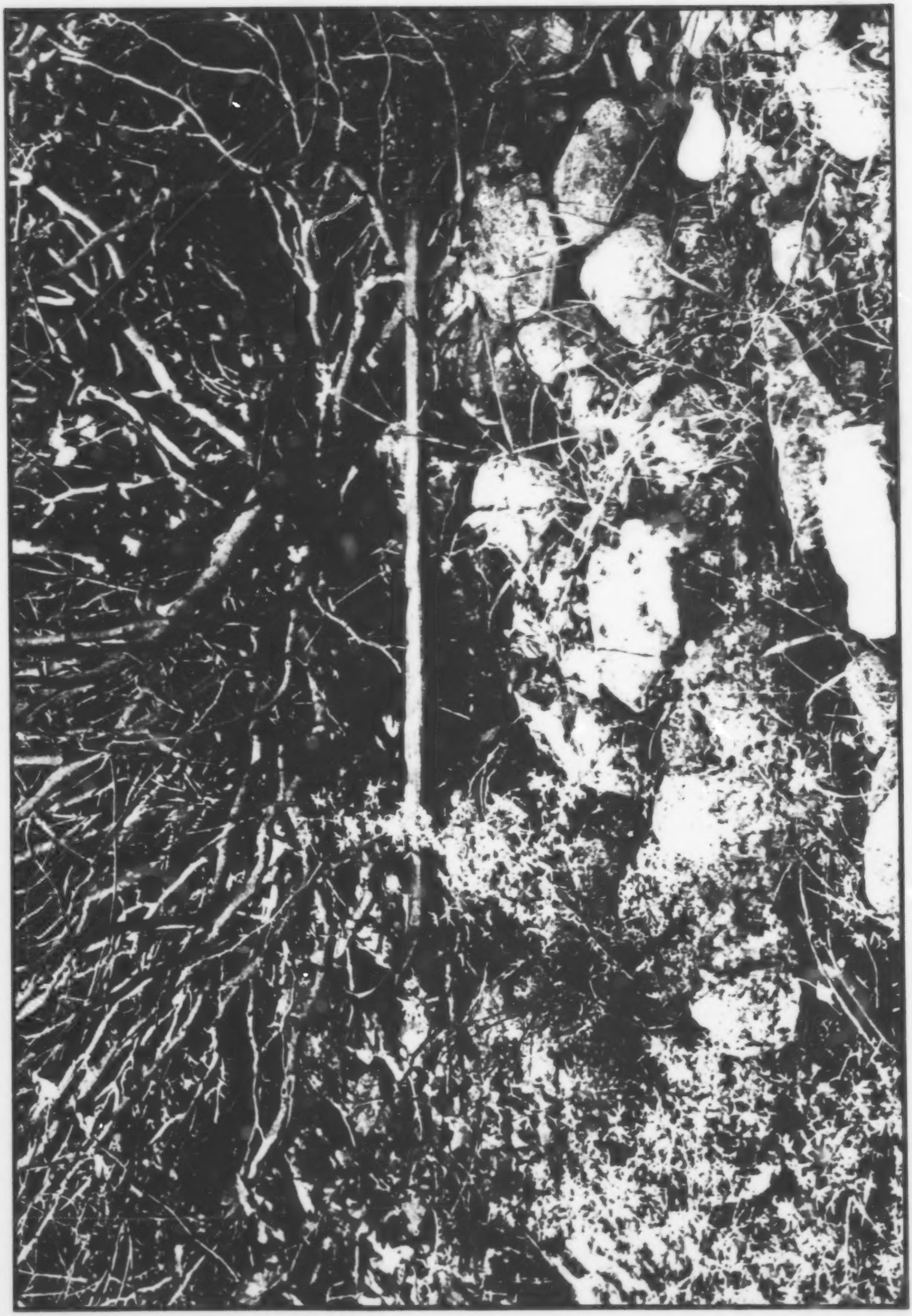


Figure 27

Little Grand Lake mound after dismantling proposed timber harvesting area in the Little Grand Lake region, given the nature of the information recovered, must be extremely brief.

It is generally recognized that the aboriginal populations of the Island of Newfoundland exploited primarily the resources of the coast (Tuck and Pastore, 1985) and that the "fallback" species of the interior were few in number, susceptible to human predation, and did not provide the "bottom line" subsistence found in the boreal forest of mainland Canada. The only exception is the caribou, which may have been hunted during their annual migrations by any of the various peoples who occupied the Island of Newfoundland over the last five millennia. However, it is not certain whether regular large-scale hunts in interior parts of the island were a regular feature of the seasonal rounds of any of the prehistoric occupants of the island. Without doubt, the Beothuks conducted such hunts during the latter years of the historic period, but it seems likely that this adaptation was a response to European presence in favoured coastal locations which denied the Beothuks access to their preferred coastal resources (Tuck and Pastore, 1985). It seems doubtful, therefore, whether the utilization of the interior of the island was ever extensive.

This situation appears to be reflected by the results of the present study. As far as could be determined, the immediate study area is devoid of archaeological remains detectable by traditional means.

3.7.5 Recommendation

Based upon the negative evidence found in the study area, no further archaeological research is recommended. However, the following suggestions should be taken into consideration:

1. Those sites identified as having relatively high archaeological potential (Areas 3, 4, and 6), are outside the areas targeted for harvesting and are unlikely to be disturbed. However, if future operations propose use of those sites, a more thorough ground survey of the sites is recommended.

2. Supervisors and other personnel employed by Corner Brook Pulp and Paper should be made aware of the importance of historic resources which might be discovered accidentally during the course of logging operations. These resources are made all the more important by the meager nature of archaeological information from the interior of the Island of Newfoundland. Any unusual features such as: a) rock or earthen mounds or alignments not obviously of natural origin; b) traces of rock hearths or other evidence of confined burning; c) concentrations of bone, no matter how small or how fragmented; and d) any suspected artifacts, whether stone tools or European materials, should be reported immediately to the Historic Resources Division, Department of Culture, Recreation and Youth.

3. Work in areas where such materials or features are reported should stop immediately and not resume until the location has been inspected by a qualified individual.

3.8 RESOURCE USE

3.8.1 Fishing

Residents of the west coast use Grand Lake for recreational fishing. A number (10-15) of cabins have been constructed in the southwest corner of the Lake, and trailers are placed in the area seasonally (J. Marshall, pers. comm.). There are no data on the level of effort by anglers or on the catch taken each year. This is not surprising, since for Newfoundland such information is only collected for (sea-run) Atlantic salmon and not for fresh water species.

Access to Little Grand Lake is by a gravel road in summer, and a few people fish the ponds along the road around the west end of the Lake. Little Grand Lake itself is not very productive (Menchenton, 1987, pers. comm.).

While the cabins and trailers are outside the study area, angling (and boating) takes place along Grand Lake itself, as well as from some of the inflow tributaries to the west and southwest of the Lake. Trophy sized trout are taken, especially in the fall of the year. Land located salmon (ouananiche) are also taken.

There are a number of cabins on the western end of Island Pond. Angling is presumably one of the recreational pursuits undertaken in the area.

3.8.2 Hunting

This area of western Newfoundland is heavily hunted, but steep terrain and difficult access have limited the hunting pressure in the study area, particularly in the section north of Little Grand Lake. The big game kill statistics for the 3-year period 1985-87 shows that 88% of the moose and 53% of the caribou taken in the study area during that time were killed south of Little Grand Lake (Table 17). Table 17 also shows that the percentage of moose kills in that part of the study area north of Little Grand Lake is increasing as road access is being provided. A similar trend is not yet evident for caribou.

The study area contains one commercial hunting camp; it is located on Island Pond south of Little Grand Lake (Figure 28). The next closest camp to the study area is on Little Lake, approximately 5 km beyond the eastern boundary.

Small game (rabbits, ptarmigan) hunting is not a major activity in the study area. However, a number of individuals do pursue the sport (including rabbit snaring) by road and by snow machine. In the latter case, snow machines are taken by boat across Grand Lake and access to the study area (and areas to the east) is via Lewaseechjeech Brook — Little Grand Lake or one of the other smaller brooks just north of Little Grand Lake. These winter journeys frequently extend to the Buchans road.

Other Recreational

Skiing, camping and canoeing are not major activities in the study area. Both Grand Lake and Little Grand Lake have traditionally supported some water based activities associatedwith fishing. This may increase at Little Grand Lake if road access improves. There may also be some increase in camping activity (most likely associated with hunting and fishing) because of road access.

3.9 AESTHETIC VALUES

The study area possesses the high quality scenic landscape features so common on the west coast of the island: steep, upland slopes in combination with river/lake systems. The shorelines of both Grand and Little Grand Lakes are examples of these scenic values.

Aesthetic quality may also be evaluated in terms of the relationship which it has with wilderness and outdoor recreational values. Where the two latter values are strong, the aesthetic qualities are more significant than where the two associated values are less strong. In the Little Grand Lake area the present wilderness qualities would not be highly rated; the presence of roads and clearcuts from former logging activity, the existence of a commercial hunting camp, and the regular (though modest) winter use of the area by snow machines.

Similarly, outdoor recreational values are not highly rated. The Resource Atlas for the island of Newfoundland (Dept. of Forestry and Agriculture 1974) rates most of the study area as having low to limited capability for outdoor recreation. Thus, while some sections of the study area are of high value from the strictly aesthetic perspective, integrated aesthetic values are less significant.

Big game kill statistics for study area, 1985-87.

	South of Little Grand Lake		North of Little Grand Lake	
	Moose	Caribou	Moose	Caribou
1985	33(100%)	2(50%)	0(0%)	2(50%)
1986	35(90%)	7(64%)	4(10%)	4(36%)
1987	23(74%)	10(48%)	8(26%)	11(52%)
Total	**91(88%)**	**19(53%)**	**12(12%)**	**17(47%)**

Table 17

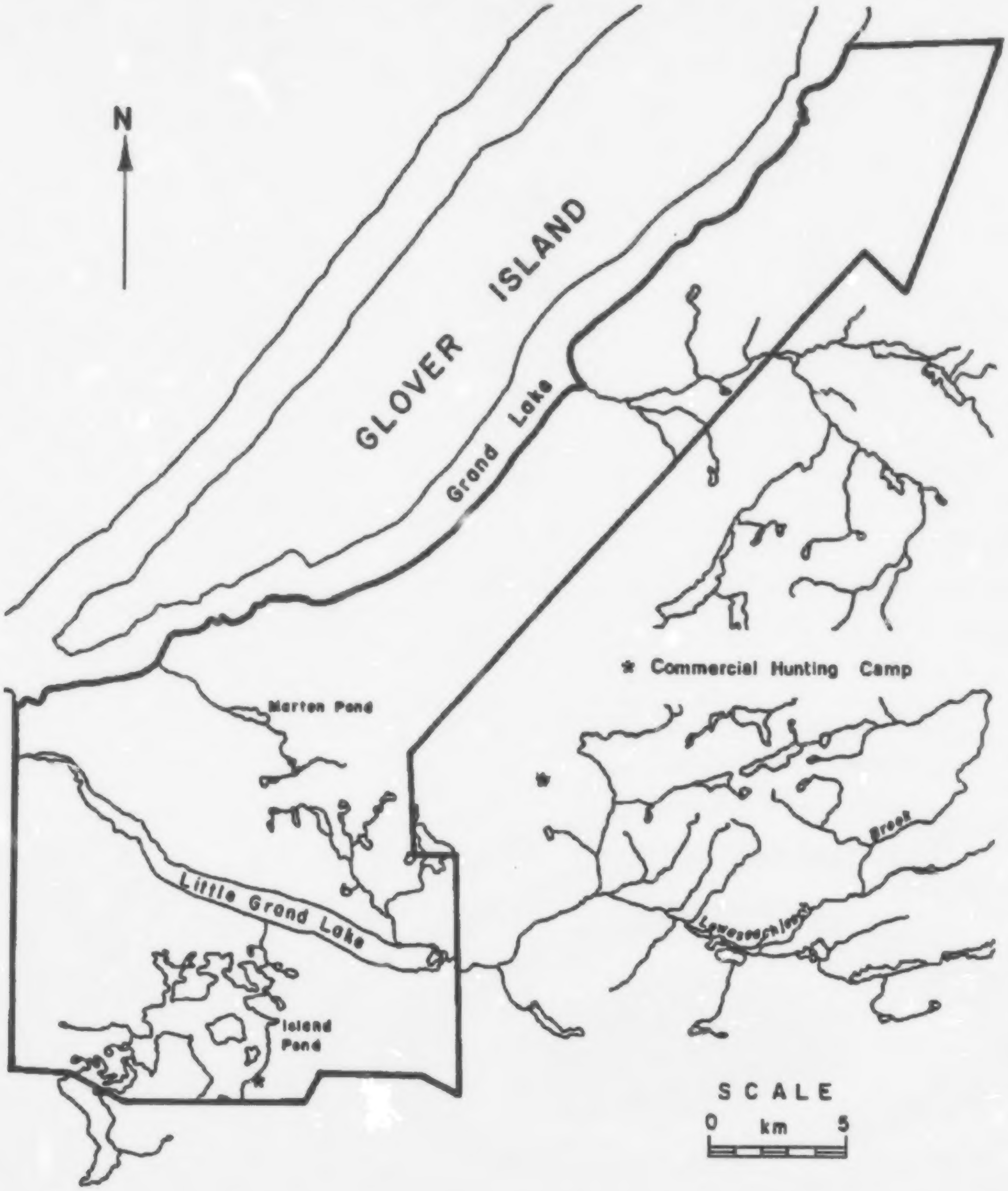

N
GLOVER ISLAND
Grand Lake
Marten Pond
Little Grand Lake
Island Pond
* Commercial Hunting Camp
Lewaseechjeech
Brook
SCALE
0 km 5

Figure 28

Location of commercial hunting camp in Little Grand Lake study area

4.0 PUBLIC INFORMATION PROGRAM

GENERAL

A public information meeting to describe the harvesting and management operations proposed for the Little Grand Lake area was held at the Glymill Inn in Corner Brook on December 3, 1987. There were two sessions; in the afternoon from 3-5 pm, and in the evening from 7-9 pm.

The information sessions were announced three weeks in advance (weekly and twice-weekly insertions) in west coast newspapers and three days (daily basis) in advance on local radio. The announcements identified the Proponent, specified the location and times of the session, and explained the purpose of the sessions.

At each session the Proponent was represented by G. vanDusen and S. Weldon, the Consultant by T. Northcott, and the Department of Environment by V. Watkins.

Session Structure

Three 1.0 m x 1.5 m free-standing information panels were the focus of the information session. The three panels displayed:

Panel 1: Proposed Harvest Plan:

- areas to be harvested,
- areas not being harvested, and
- locations of access roads.

Panel 2: Major Environmental Concerns:

- pine marten,
- steep slopes,
- historic resources, and

for each of the above, the nature of the concern was given, and the action taken by the Proponent to address the concern was discussed.

Panel 3: Other Topics:

- other environmental concerns;
- fisheries
- hunting
- other recreation, and
- mineral resources
- outline of study report;
- methods,
- description of existing environment,
- potential impacts,
- mitigative measures, and
- monitoring programs.

In addition to the information panels, a pamphlet explaining the rationale for harvesting in the Little Grand Lake area was distributed at the sessions. The pamphlet also outlined the Environmental Assessment process, identified the role of the public in this process, and named contacts from whom more information could be obtained. A copy of the pamphlet will be found at the end of this section.

A register was placed at the entrance to the meeting room, and "Comments" forms for visitor use were available next to the register. Realizing from experience that few written comments would be received, representatives of the Proponent and Consultant took notes on the questions and comments raised at each session.

Attendance

The attendance register contains 21 signatures, and there were a small number of individuals who did not sign the register. Total attendance is thus estimated to be 25-30 people, approximately evenly divided between afternoon and evening sessions.

Half of the individuals attending the sessions were affiliated with one of the following: Proponent, Consultant, Provincial Government (Departments of Environment, Forestry, Development and Tourism), the media (radio, TV, newspaper), and Memorial University (Grenfell College). The remainder had no particular affiliation, and most were loggers or logging contractors.

Public Comments

No written comments were received after the information sessions. But a number of questions were raised, and comments offered, at the sessions.

The wood harvesting plan and extraction schedule, and the potential for the operation to create new jobs, were of considerable interest. A number of those attending the sessions were contractors and woods workers, and the timing and scale of the proposed operation were important to them.

The pine marten was also of general interest to many attending the sessions. There were questions about habitat requirements, food habits, and the nature of the marten study carried out at Little Grand Lake. One individual, a part-time trapper, was concerned about the additional pressure that the wood harvesting operations might place on marten. He wondered if the Proponent and the Crown could arrange an exchange of timber so that Little Grand Lake could be left unharvested.

A number of people asked about the rock mounds discovered during the historic resources survey; did the mounds indicate use of the area by the Beothucks (the mounds appear to be more recent than that) and was there any other evidence that Beothucks may have used the area (there was not).

There were no questions about the steep slopes in the area proposed for harvesting.

Corner Brook Pulp and Paper Limited

Little Grand Lake

Environmental Assessment

Public Information Session
Corner Brook, 3 December 1987

Introduction and Background

Corner Brook Pulp and Paper Ltd. (CBPPL) proposes a long term forest management and timber harvesting program in the Little Grand Lake area in order to supply its newsprint mill at Corner Brook. The Company plans to harvest approximately 65,000 m^3 of pulpwood per year from the study area. Harvesting operations will take place on approximately 40% of the land base within the study area. Steep slopes, wetland and alpine areas will not be harvested.

In 1986 and 1987 some harvesting was conducted in the study area under an exemption from the Minister of Environment and in conjunction with research being carried out on the interaction of forest harvesting and the Pine Marten.

Much of the area to the west of the study area has been harvested by CBPPL over the past twenty years. This forest has regenerated and is now being intensively managed by the Company. As the timber in the study area is harvested, these young stands will mature and be ready for harvest a second time. The entire area will be managed by CBPPL to provide a sustained supply of raw material for the Corner Brook Mill.

Environmental Impact Statement

Following review of the project registration under the *Environmental Assessment Act* (1980), the Minister of Environment required that CBPPL prepare an environmental impact statement (EIS) for the proposed harvesting operation.

This EIS will provide information on the proposed operation and on the existing environment to facilitate an assessment of the environmental acceptability of the project. The potential impacts on the existing environment will be identified and mitigative measures will be outlined. Environmental monitoring will also be discussed.

The EIS will focus on the three major concerns (valued ecosystem components)which have been identified by CBPPL and government departments:

- the Newfoundland Pine Marten
- historic resources (archaeology)
- steep terrain

Original studies are being carried out to evaluate these three concerns. Elements of the environment which have not been determined to be valued ecosystem components will be discussed using existing information only.

Study Personnel

Corner Brook Pulp and Paper Limited has retained NORTHLAND ASSOCIATES LIMITED of St. John's to carry out the study and to prepare the EIS. The actual field work for the two year pine marten study was undertaken by the Newfoundland Wildlife Division and graduate students of Utah State University, Logan, Utah.

Public Information Session

This session is being held:
- to provide a description of the project;
- to outline CBPPL's approach to the impact assessment; and
- to record any concerns that the public may have regarding the project.

Please sign the register before you leave. We invite you to express your views of the project on the forms provided, or to us personally.

EIS Report

A report containing the results of all the studies will be submitted to the Department of the Environment early in 1988. The report will incorporate (where appropriate) the comments and suggestions from this public information session.

More Information

If you wouild like more information please contact:

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Chief Forester
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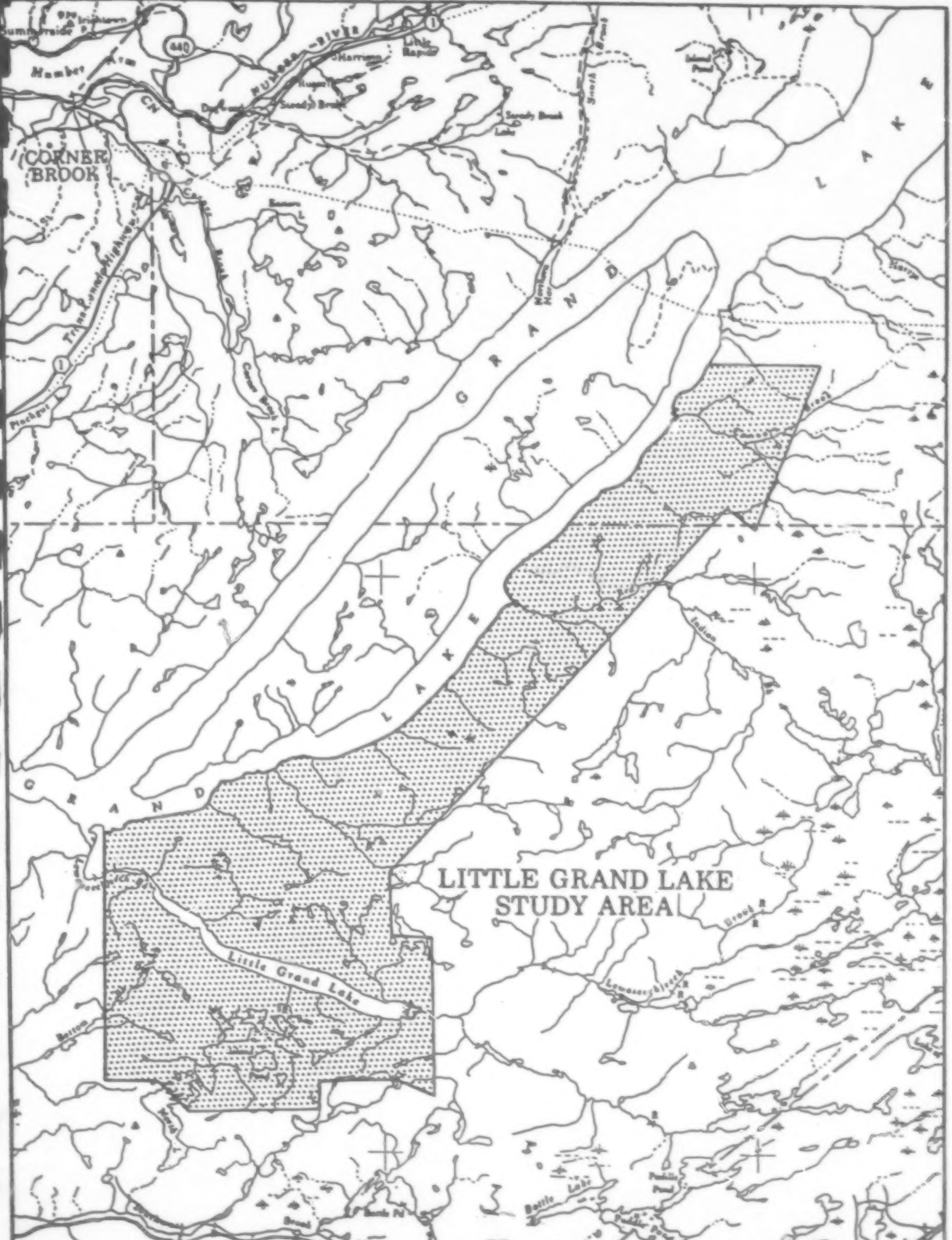
A2H 6J4 Tel: 637-3322

Mr. Tom Northcott
Northland Associates Ltd.
P.O. Box 1734
42 Powers Courts
St. John's, Newfoundland
A1C 5P5 Tel: 754-2052


Irishtown
Summerside
Humber Arm
440
1
HUMBER RIVER
Little Rapids
Harrisons
Pasadena
Sandy Brook
Sandy Brook Lake
CN
CORNER BROOK
Trans Canada Highway
Island Pond
GRAND LAKE
GRAND LAKE
Little Grand Lake
LITTLE GRAND LAKE
STUDY AREA
Lewaseechjeech
Brook
Puddle Pond
Bottle Lake
Pinchgut

COMMENTS AND QUESTIONS

Your comments and questions on the proposed harvesting of timber from the Little Grand Lake area will be a factor in determining the environmental acceptability of this project.

Please use the space below for comments or questions. You may leave the form here, or mail it to the address below.

George VanDusen
Chief Forester
Corner Brook Pulp and Paper Limited
P.O. Box 2001
Corner Brook, Newfoundland
A2H 6J4

5.0 IMPACT ASSESSMENT

Environmental impact assessment is a predictive planning tool that provides environmental information to project decision makers, identifies the potential effects of the proposed project, and suggests measures to ameliorate those effects (Beanlands and Duinker 1983). In preparing the EIS for the proposed Little Grand Lake timber harvesting operations, details of the undertaking have been carefully considered with respect to valued ecosystem components in order to identify and minimize potential impacts.

The long-term and incremental activity which characterizes forest management/wood harvesting operations is quite unlike the short-term and rapid changes which are usually associated with other developments (e.g. hydroelectric); these differences must be considered when predicting and evaluating potential environmental impacts. At Little Grand Lake, changes (both positive and negative) will take place slowly and only in a small portion of the area at one time. Sections of the land base that may be affected in the early years will have begun to recover as later areas are opened up for harvest.

It is a question of whether or not, given proper planning, timber harvesting operations can be carried out at Little Grand Lake in an environmentally acceptable manner. In particular, can the project proceed without significant effects to the valued ecosystem components of the study area?

The discussion of impact presented here is based both on the results of the original research undertaken for this study, and on the review of available information obtained from the literature and from interviews with knowledgeable individuals. The focus is on a consideration of the impacts to the valued ecosystem components (pine marten, steep slopes, historic resources). However, the potential impact of the proposed operation on all components of the environment are addressed, albeit in less detail for those deemed to be of less value.

As a basis for identifying impacts to the physical environment, each potential impact was evaluated in terms of its duration, frequency and magnitude of occurrence, and geographical extent. A rating (minor, moderate, etc.) was assigned, based on the evaluation.

Population-based criteria were used to rate the significance of potential impacts to the biota. These ratings (adapted from Conover *et al.* 1985) are as follows:

- major impact: affects a whloe stock or population of a species to a point where it causes a decline in abundance and/or a change in distribution beyond which natural recruitment would not return that population, or any population or species depending on it, to its former level within several generations.
- moderate impact:affects a portion of the population to the point that a change occurs in the abundance and/or distribution (over one or more generations) of that portion of the population or any population depending on it, but does not change the integrity of any population as a whole. Impact is localized.
- minor/negligible: either affects a specific group of individuals in the population at a localized area for a short period of time, or the effect may be so small as to be indistinguishable from the small random population changes that take place naturally.

5.1 STEEP TERRAIN

Detailed analysis of the large scale black and white aerial photography revealed that of the 21 areas designated as being potentially environmentally sensitive in Stage 1, six areas (comprising eight sites) have maintained this status with respect to forest harvesting operations. In the remaining 15 areas conventional harvesting practice will include the use of buffer zones around lakes, streams, and ponds, and the proper design and construction of roads will be observed. These areas represent Land Systems which in our opinion, do not warrant special consideration if reasonable care is taken in the field.

Of the six areas still considered to be potentially sensitive, it may be said that the concerns expressed in the project registration, and in the terms of reference, over steep slope erosion now manifests itself in these six areas. The remainder of this section will examine the potential impacts of logging operations on terrain in general, and on these six areas in particular. This consideration of impact will deal mainly with an assessment of the potential for severe erosion.

Slope gradient is, of course, one of the most important factors governing slope stability. But two other factors are also quite important: type of soils, and amount of precipitation. The study area receives about 1000 mm of precipitation annually (Section 3.2). While this is a fairly impressive total, it is spread out through the year as rain and snow rather than being concentrated in one short period; rapid, large-volume water inputs represent the most serious precipitation trigger for erosion (Megahan 1972). In the study area, the greatest amount of precipitation in a 24 hour period comes as rain in September. If this heavy rain event had occurred during the spring snowmelt, surface and subsurface flows would likely cause much erosion of slopes. As it is, precipitation would not appear to be a major trigger for slope erosion on the study area.

Study area soils are mostly of glaciofluvial origin. These stony to moderately stony soils, with sand and sandy loam components, have a low to moderate erodibility potential (VanKesteren 1986). Such soils are quite stable. Megahan (1972) described similar soils in the hilly sections of Idaho as extremely stable. Thus, the soils of the study area will offset to a large degree the erosion hazard represented by steep slopes.

The steep slopes represent a problem only if the activities associated with the wood harvesting operation cause a substantial disturbance of the terrain; if the surface disturbance is severe and widespread, erosion could become a problem regardless of the normally stable soils. Surface disturbance can result from cutting/skidding activity, and from the construction and use of roads and landings.

Skidder logging operations can cause a variety of ground disturbances ranging from litter removal to deep exposure of the mineral soil (Case and Donnelly 1979). While the soils of the study area generally have a low to moderate erodibility potential, improper road location and excessive bulldozing may still give rise to an erosional problem. Also, the use of inappropriate equipment can exacerbate the problem. For example, a report prepared by the Forest Products Division of the Department of Forestry and Agriculture (Pickett 1987) determined that the use of wide tires on skidders harvesting in the Marten Pond area produced 0.8% heavy disturbance, compared with 6.5% heavy disturbance from conventional tires. This suggests that with careful planning of skid roads, and the use of proper equipment, harvesting can be carried out at Little Grand Lake with minimal site disturbance. The potential for disturbed terrain to undergo surface erosion depends on the detachability of soil particles (the ease with which soil particles can be detached); inherent soil characteristic forces applied (wind, rain, gravity); and surface cover (materials, such as litter, which protect the soil) (Megahan 1972). The generally resistant soils of this region of western Newfoundland have resulted in minimal surface erosion on cutovers examined in the study area and in similar adjacent areas.

Megahan (1972) reported similar findings from a study of erosion potential from logging in Idaho; he concluded that the overall erosion hazard from cutting and skidding is small. The Idaho study suggests that cutting and skidding increases surface erosion 1.6 times. But, as Megahan (1972) points out, vegetation regrowth and seasoning of the erosion surface tend to reduce surface erosion in a short time; he quotes several studies which determined that after approximately two years the erosion rate is similar to the pre-logging condition.

Thus there is a time trend rather than an even rate in surface erosion of cutovers. With the stony and moderately stony sandy till soils of the study area, even the initial period of one or two years should not see any significant erosion on cutovers. The scattered patchy nature of the ground disturbances noted in Area A (i.e. no large contiguous disturbed patches) suggests that any soil movement would be intercepted by intervening undisturbed areas. Also, the revegetation noted on the areas visited (crackerberry, *Cornus canadensis*; ferns, and a number other species) two years after the cutting suggests that cutovers will be sealed quickly against erosion. Some older-aged cutovers just outside the study area support considerable minor vegetation, and the presence of seedling commercial species is evident (Figure 13D). No erosion problems have been demonstrated on theses older cutovers. Because the evidence indicates that they are unlikely to be subjected to any significant amount of erosion, cutovers will not contribute sediment-laden discharge to the aquatic environment. The major environmental concern with respect to erosion is the degradation that sediments can cause to aquatic ecosystems because increased siltation of watercourses can lead to loss of spawning and rearing habitat for fish, and loss of waterfowl habitat.

Erosion impacts to the terrestrial environment of cutovers include reduced site productivity (delayed regrowth of forests on the site) and an associated loss of productive wildlife habitat.

While surface erosion on cutovers is usually of small consequence, the erosion hazard from such bulldozed areas as roads is greater. Surface soil and litter are generally absent from haul roads, and the surface is compacted. These conditions can lead to increased surface flows of water on the road, and hence erosion, particularly if the road is not properly located. Megahan (1972) reports that surface erosion on some roads in the Idaho logging study increased by 220 times. However, the same large reduction in erosion hazard after two years applies to roads as well as cutovers. And in the Little Grand Lake study area the resistant soils will permit only a limited amount of erosion in that initial period, particularly if the roads are properly located with respect to contours.

Nevertheless, the increased runoff associated with improperly constructed roads is generally a concern. Channelization, coupled with the removal of forests can serve to increase and concentrate surface runoff to water courses. This may cause increased peak flows (and reduced minimum flows) in streams, which in turn may cause bank and channel erosion. These events are particularly critical in smaller streams.

The amount of bulldozer disturbance associated with skidder logging hauling roads was measured by Case and Donnelly (1979). They found that the greatest amount of ground disturbance in their study area on the east side of Grand Lake was associated with the summer use of short-term extraction roads. This extraction road damage (which caused disturbance to 5% of that particular cutover) represented 65% of the ground disturbance produced by that operation. Lesser amounts were attributed to secondary and primary hauling road construction.

The feature of road construction of most concern, particularly for the major roads, in hilly terrain is the frequency of cuts and fills. The desire to limit the width of the right-of-way often results in quite steep slopes on both the cuts and the fills. These steep slopes constitute a potential erosion hazard since both slopes could fail. Such a failure is termed mass erosion, the movement of soil particles en masse (e.g. landslides). Mass erosion occurs when heavy rain or melting snow causes subsurface flows. Unlike surface erosion, mass erosion shows no distinct short-term time trend (Megahan 1972).

Landslides are characteristically a feature of spring; as described by Megahan (1972) they are most often rain-on-melting-snow events. A review of the pattern of precipitation in the study area (Section 3.2) indicates that spring (March - May) is the period of least total precipitation, and that the least precipitation in a 24 hour period also occurs in the spring. Under such a climate pattern, the incidence of mass wasting should be somewhat reduced.

Although there is a potential for erosion to occur as a result of the timber harvesting operations at Little Grand lake, the evidence suggests that, with the proper construction techniques and mitigative measures (Section 6) the erosion will not be severe. And, particularly significant, any eroded soils that are moved down slope as a result of the operation are unlikely to find their way into a water system. The more significant water bodies are in the southern portion of the study area (Little Grand Lake and south) where no harvesting is proposed.

The major harvesting areas are in the central and northern parts of the study area, and a close inspection of timber stands targeted for harvesting will reveal that few of these stands are near the limited number of water systems present in these sections. The largest potential siltation hazard will come from the construction of the main access road through the study area, a hazard which can be controlled and monitored better than any other road type.

5.1.1 Detailed Description of Sensitive Sites

The following eight sites are potentially environmentally sensitive and require special attention and consideration during field operations.

Area A (Figure 12 and Map 4), a vegetated zone separating two areas of organic wetlands to the northwest and southeast, possesses a fairly steep slope, and it is believed that the removal of vegetation may substantially alter drainage, resulting in mass movement and/or surface erosion from the higher organic region to the extensive lowland bog. The merchantable timber borders the organics with an abrupt boundary due to slope; natural buffers may not provide adequate protection for these areas. If a generous margin were left adjacent to these areas and respecting the natural slopes, potential problems would be mitigated.

Area B (Figure 12 and Map 4), contains a substantial percentage of organic soil, and ground disturbance may have serious effects. This unit borders a significant wetland area and may be susceptible to compaction damage from heavy equipment. A major surficial deposit located in the eastern part of this unit may be a natural boundary.

Area C (Figure 12 and Map 4), contains a high percentage of organic wetland and has a hummocky appearance. Drainage from several lakes proceeds through this area in a southerly direction and should not be impeded or facilitated. Also, the relatively large lakes located just to the north of the cut block represent a natural storage unit, and the use of heavy equipment adjacent to these areas may change the drainage pattern resulting in increased erosion and subsequent siltation downstream. It may be a reasonable strategy, in this region, to locate the road in a more southerly direction and restrict movement across the major drainage features.

Area D (Figure 12 and Map 4), is located in Land System 6 (Colluvial Slopes), which was delineated as being sensitive on the basis of slope. Based on its location, harvesting will occur on a relatively steep slope and logging down this slope past the point of inflection may result in increased erosion and mass wasting. The proximity of this area to both a high energy stream and a lake render it a critical area in terms of potential erosion and siltation.

Area E (Figure 12 and Map 4), occurs in Land System 12 (Patterned Forest/Bog Uplands) which was determined to be sensitive on the basis of drainage. In this area road locations both cross, and run adjacent to, a major drainage feature. The drainage is to the lake in the north and is the major outlet draining large wetland areas to the west and east. Impeding or facilitating drainage in this area may have damaging consequences. In addition to the consequences related to road location, harvesting of timber in areas where the merchantable stocks are found directly adjacent to organic terrain may also have adverse consequences. The absence of a natural buffer other than merchantable timber in these areas requires that some merchantable timber remain uncut to provide a buffer in order to ensure the least possible disruption.

Area F (Figure 12 and Map 4), is an area of concern because of the presence of both harvesting and roads. Again this area contains an important drainage feature; it represents the only outlet draining the large wetland area in the south to the lake in the north. Facilitating or impeding the drainage at this site may prove to be detrimental to the area in terms of increased erosion and siltation or the eventual creation of new drainage features and associated subsequent erosion and downstream siltation.

Both *areas G and H* (Figure 12 and Map 4), occur in Land System 9 (Upland Drainage Slopes), originally designated as sensitive on the basis of erodibility. The area is hummocky and contains much organic terrain. Areas G and H follow a fairly well developed drainage feature proceeding from several lakes in a northwest direction. Considering the abundance of organic soils in this area, this drainage should not be disrupted. In this area normal buffering practices may not be adequate and special attention should be paid to areas G and H. For example, an additional margin may be considered appropriate where these two units occur adjacent to harvesting operations. The removal of vegetation immediately bordering these units and normal use of harvesting equipment may cause excessive erosion and associated siltation.

5.2 FISHERIES RESOURCES

The major potential impact of this project on fish will result from habitat alteration both as a consequence of cutting operations and road construction.

Cutting, slashing, hauling and piling timber will remove riparian vegetation and disturb surface vegetation cover. This can result in increased erosion of soil and fines into streams. The loss of riparian vegetation can reduce fish food (stream drift), degrade habitat (loss of cover) and alter temperature regimes through increased exposure of water to direct sunlight.

The utilization of a buffer zone can act to greatly decrease the severity of these impacts.

Road construction will create stream bank disturbance and velocity changes as a result of fording and culvert installations. Where sites are forded, the main concern relates to disturbance to stream banks. Removal of riparian vegetation and physical disturbance of banks can produce erosion of fine material into the stream. The benefits of shade and input of organic material into the stream can be lost if riparian vegetation is disturbed. Erosion into the stream can alter the consistency of stream substrate. The major impact would be to spawning gravel should incubating eggs be smothered, or if fish refuse to spawn in an area because of siltation.

The movement of mechanized equipment across a ford site can result in unintended release of oils or fuels into the water.

Where crossings are achieved by culvert installation, the concerns of stream bank disturbance and siltation are added to by the alteration in the stream bed and in the water flow character which will occur. The immediate crossing area is covered over with fill material and all flow directed through culverts so that a small section of natural habitat is lost. The concentration of flow into culverts tends to increase velocity and this can create a migration barrier for some sizes and species of fish.

If improperly placed in the stream bed, the downstream end of the culverts can have (or water flow can create) a vertical drop which can also act as a barrier to upstream movement. At low flows the flow across a section of culverts can be dispersed so that a barrier is created under these conditions.

Bridge construction and operation involves minimal concern for velocity related problems, but can be a siltation concern if road drainage is directed into the river or if abutments are not properly stabilized.

The most significant and unavoidable impact will be realized at the actual road crossing sites where the riparian vegetation and (in the case of the culverts) stream habitat will be directly altered. At each crossing an approximately 20 m section of stream will be directly impacted.

The implementation of the practices and precautions described by McCubbin *et al.* (1985) with reference to road construction and operation as well as wood harvesting will greatly diminish the potential impact of this project on fish and aquatic habitat.

The impact of the project on riparian and stream habitat downstream of each crossing site will be minor, direct, negative, and of short term (construction period) duration.

The impact of the project on riparian and stream habitat areas will be minor, direct, and of long term (permanent) duration.

5.3 WILDLIFE RESOURCES

5.3.1 Pine Marten

The two major effects of logging on marten populations at Little Grand Lake relate to loss or alteration of habitat, and potential change in the food base. The former has the potential to be negative, the latter is more likely to be positive. Each is discussed below.

5.3.1.1 Habitat Loss or Alteration

The marten's preference for mature coniferous or mixed coniferous forest is well documented in North America (see Section 3.6.1.1 for references). Alteration of mature forest habitat is generally associated with reduced marten populations. Thompson (1986) considers that logging creates suboptimal habitat for marten, and estimated that marten densities were lower by 67-90% (depending on population levels) in particular logged areas in Ontario. Studies in Newfoundland show that marten use clearcuts less frequently than uncut areas (Snyder 1984, Bissonette *et al.* 1988).

Marten habitat selection appears to be related to a number of factors including prey abundance and availability, suitability of denning and resting sites, nature of overhead cover, and season of the year (Snyder 1985, Thompson 1986). While densities are generally lower in disturbed areas, marten do remain as residents of such areas, adapting to them with greater or lesser success depending on the mix of factors given above. Snyder (1985) reports the findings of a number of researches who conclude that, if sufficient undisturbed forest is left in the form of residual stands or corridors, a reduced number of marten will likely continue to remain resident in the area. Snyder also cites examples of the marten's adaptability by reporting the findings of a number of studies which show marten using deciduous forest, talus slopes, and arctic barrens.

It seems probable, therefore, that logging at Little Grand Lake could alter the mature forest habitat to the point that fewer marten would remain resident in the immediate area of impact. The findings of the two-year study at Little Grand Lake (Bissonette *et al.* 1988), and a consideration of the portion of the regional marten population that could be occupying the study area will give some indication of the significance of the potential impact.

The two-year study of marten at Little Grand Lake (Bissonette *et al.* 1988) indicated that the logging activities carried out as part of the experimental program had very little negative impact on the radio-collared study marten. Five experimental marten provided radio signals for a sufficient period of time to evaluate movement, and none of these animals left the study area during the approximately three months (August 4 - November 14) of logging in 1986. In addition, all five of the control marten remained in the study area (some crossed from the control to the experimental portion of the study area) during logging.

At Little Grand Lake, only three marten provided sufficient radio signals to compare pre and post-logging home range size. An experimental animal showed a decrease of 25% in the overall home range size but no change in the size of the core range area. Of the two control animals, one showed essentially no change in home range size. And the second control home range increased by 100%; most of the increase was annexed experimental area.

The radio signals picked up from clearcuts at Little Grand Lake represented 11.5% of signals from young animals, and 2.2% of signals from adults. However, these figures do not include the frequent use by marten of the clearcut area around the researcher's camp.

Bissonette *et al.* (1988) estimated that the Environmental Assessment Area (EAA) can support 147 marten (62 males and 85 females). If only half of the females produce kits each year, and assuming an average litter of 2.5 kits, 108 kits may be produced in any given year within the EAA.

The high density marten area designated by the Wildlife Division encompasses the EAA, and is approximately three times larger than the EAA. Using the density figure of 0.26 marten per km^2 calculated by Bissonette *et al.* (1988) for the EAA, the high density area could support approximately 435 marten. The Wildlife Division's estimate of density in the high density area is 0.12 marten per km^2 (Snyder 1985). Using this figure, the high density area could support approximately 200 marten.

The mature forest stands targeted for harvesting on the study area represent approximately 5% of the high density area and 10% of the EAA. Using the latter for comparison, logging in the study area will alter the habitat of approximately 15 marten, assuming an even distribution throughout the EAA. Based on the male:female ratio given in Bissonette *et al.* (1988), nine of these 15 marten would be females. Assuming that four of these females will each produce 2.5 kits, a maximum of 10 kits might be expected to be produced each year in the areas targeted for harvesting. But logging activities are unlikely to cause the loss of 10 kits from the annual production. Few kits are born in years of prey scarcity. And, the sequential harvesting of a small percentage of the targeted mature stands each year, plus the availability of adjacent mature stands not targeted for harvesting (approximately 50% of the mature forest in the study area will not be harvested) suggests that loss of kit production because of logging may be 10 or less. This represents 10% or less of the kits expected to be born in the EAA. It is impossible to say at the present time if such a loss will be significant.

We believe that while logging will alter some of the study area habitat in a manner unfavourable to marten, that marten (probably fewer in number) will continue to occupy the study area. As stated previously, uncut stands and travel corridors will reduce the impact of harvesting. Marten have been shown to be adaptable, and to use cutovers on occasion, particularly in summer and during periods of prey scarcity. Marten are opportunistic or generalist predators, and in years with poor food availability (a normal situation for marten in Newfoundland) marten may take almost as much food in cut areas as in uncut ones; Thompson (1986) reported that marten obtained 21% more food in uncut areas than in cutovers in such years. Also, Thompson (1986) observed that marten living in cutovers did not behave remarkably different from those in uncut areas; even hunting techniques were similar, except that marten moved faster and further in cutovers. Thus, marten can use and live around cutovers, albeit at reduced efficiency. However, as Thompson (1986) stated, hunting efficiency in cutovers would be considerably improved if marten take advantage of some food items (e.g. snowshoe hares, grouse) which are more common there. Thompson believes that if marten are free to become adjusted to cutovers (trappers in Newfoundland and elsewhere take a high percentage of their marten catch in cutovers, and hence the animals do not survive to learn) it is reasonable to expect that they would develop certain behaviourial modifications to hunting which will eventually increase the success of living on logged sites.

Some marten would, of course, be expected to abandon areas that have been logged, perhaps even move out of the study area entirely. Given that the areas proposed for logging represent such a small portion of the EAA and the high marten density area, there would appear to be considerable undisturbed habitat available.

5.3.1.2 Food Availability

Newfoundland's depauperate small mammal prey base has likely been a major limiting factor for marten populations. The meadow vole (*Microtus pennsylvanicus*) is the only native small mammal on the island, and this species has been a major food item for the marten. Since their introduction, both the snowshoe hare and the masked shrew (*Sorex cinereus*) and a number of other species have become important food items.

In Newfoundland, the major food items (on an annual basis) are meadow vole/deer mouse, followed by shrews and snowshoe hare. The frequency of occurrence of prey items in marten scats collected during the study by Bissonette *et al.* (1988) is shown in Table 18.

All of the important food items will benefit from the early successional stages of vegetation which follows logging. The crash of small mammals in the Little Grand Lake area left the results of the prey study reported in Bissonette *et al.* (1988) somewhat uncertain, but the indications are that both meadow voles and shrews are more abundant in cutover areas. Also, such larger species as snowshoe hares and ruffed grouse prefer such habitat, and will likely be present in larger numbers over time. Of course, any positive effects on the food base will not be felt quickly. The sequential nature of the logging means that it will be a number of years before positive results are evident.

Although logged areas will eventually produce larger numbers of some important prey species, the question of marten being able to avail of these prey must be considered. It seems reasonable to assume, as does Thompson (1986), that if marten are given the opportunity to become familiar with cutovers, they will develop into more effective foragers there. The position of snowshoe hare as the most frequently occurring prey item in marten scats and stomachs collected during winter (Table 18a) may be evidence of that. This table is taken from Snyder (1985) and represents 56 marten scats collected by Bateman (1982) from the Southwest Brook area during the winters of 1980-81 and 1981-82, and 25 marten stomachs acquired by Snyder (1984, 1985) from western Newfoundland trappers who accidently trapped the animals during the trapping seasons from 1979 to 1985. The stomachs were mostly from animals trapped in clear-cuts since most accidently trapped marten were taken in clear-cuts (Hancock and Snyder 1985). While little of Bateman's study area was clear-cut, open terrain (roads, powerlines, rivers, snow covered bogs and ponds) comprised 24% of the area, and softwood scrub comprised 25%.

Although 30% of the total length of marten trails recorded were in these habitat types, a comparison of track distance with the percent occurrence of habitat type indicates that these habitats were not preferentially selected by marten (Bateman 1982). Greatest preference was for balsam fir - white birch stands (Selection Index of 9.0), followed by high overstory density coniferous forest (Index of 5.0). The combined Selection Index of low overstory conifer/scrub plus open habitat was 1.1. The two preferred types also had the highest catch indices for meadow voles and masked shrews, which would likely have influenced the use of these habitats by marten.

However, the use of the Selection Index tends to underestimate the importance of open areas and low density overstory/scrub habitat to marten in Bateman's Southwest Brook study area. Although ranking quite low in terms of preference, 30% of the travel/foraging activity recorded by Bateman (1982) was in such habitat, and 43% (3 out of 7) of the marten kills reported by Bateman took place there. Unfortunately, no information on snowshoe hare distribution in the Southwest Brook areas was available at the time of Bateman's study, but it is reported that populations were at a low level. Hares prefer coniferous forest openings, edge and deadfall areas where a wide variety of both herbaceous and woody vegetation is available. The balsam fir - white birch stands and the scrub-open areas would be most likely to provide such foraging requirements; coniferous high density overstory habitat would be the least likely. And with the high frequency of occurrence of hare remains in the marten scats, it is clear that marten were accessing the restricted hare population at Southwest Brook. We believe that this is what will happen in, and around the edges of, cut-overs at Little Grand Lake.

Thompson (1986) determined that marten in his study area (north-central Ontario) exhibited an over-winter dependence on such large prey as snowshoe hares; it is energetically optimal for marten to kill larger prey items whenever possible, particularly in winter when the energy demand is high. The successful hunting of hares in cutovers in winter probably accounts for the prey analysis results reported by Snyder (1985). Also, Bissonette *et al.* (1988) recorded snowshoe hare in 3.3% of the marten scats collected in winter at Little Grand Lake (Table 18B), but no hare in scats from other seasons. This low frequency is due largely to the low numbers of hares in the area prior to timber harvesting. It was noted by Bissonette *et al.* (1988) that prior to 1986 logging, hare numbers in the area were very low. In 1987, hare numbers had increased noticeably (from 0.11 trails per day to 0.82 trails per day) in the area of the new clear-cut. We believe that marten will avail of the opportunity to hunt these larger prey items, and will use the clearcuts to do so.

In summary, the impact predicted to occur to pine marten in the study area (a localized impact that affects a portion of a population) falls within the definition of "moderate impact" as described by Conover *et al.* (1985).

5.3.2 Big Game

Moose numbers are not high in the study area (Menchenton pers. comm.). Although the mature forest represents good wintering habitat, no winter concentrations are known for the main body of the study area; two moose yards have been reported (Figure 22). While some potential (and one existing) wintering areas will be lost as this development proceeds, the blocks of mature timber left uncut are expected to be more than adequate to support the resident moose population.

As has been so frequently observed elsewhere in North America and in Eurasia, the study area moose population will likely increase following logging. The animals are attracted to the browse provided by the earlier stages of plant succession. With increased forage being made available and adequate wintering areas provided by the uncut blocks of mature timber, the proposed timber harvesting project will have a positive effect on moose populations around Little Grand Lake.

Caribou, also, will be little affected by the proposed development. The study area is neither important seasonal range nor a critical migration route for caribou (Menchenton pers. comm.). The few animals that do move through the area will probably use the cutovers where travelling is easier.

The provision of road access into the area brings with it the potential for increased hunting pressure on big game. This is not viewed as negative since the hunting pressure will now be distributed more

Table 18(A)

Frequency of occurence of prey items found in marten scats and stomach contents

(Bateman 1982, Snyder 1984 and 1985)

Prey Item	Number of samples (N=81)	Percent frequency of occurrence
Snowshoe hare	39	48.1
Meadow vole	23	28.4
Masked shrew	14	17.3
Unidentified vole and shrew	4	4.9
Caribou/Moose	11	13.6
Red squirrel	1	1.2
Ptarmigan/Ruffed grouse	4	4.9
Unidentified bird	5	6.2

Table 18(B)

Composition of marten scats by frequency of occurrence (%) (Bissonette et al. 1988).

Food Item	Spring[1] (n=20)	Summer[2] (n=87)	Fall[3] (n=57)	Winter[4] (n=30)	Total (n=194)
Microtus/Peromyscus	95.0	93.1	100.0	66.7	91.2
Sorex	30.0	5.7	21.1	23.3	15.5
Tamiasciurus	5.0	1.1	—	20.0	4.1
Lepus	—	—	—	3.3	0.5
Birds	5.0	9.2	6.0	10.5	7.2
Berries	5.0	41.4	2.0	—	19.6
Insects	—	5.7	—	—	2.6
Carrion	—	—	3.6	13.3	.1
Unknown	—	1.1	—	13.3	2.6

[1] March 23 - June 20, 1986
[2] June 21 - September 22, 1986
[3] September 23 - December 22, 1986
[4] December 23, 1986 - March 2, 1987

evenly in the region. Also, the roads will not provide access to concentrations of animals such as in wintering areas or on calving range. Thus, the improved access is not anticipated to have a negative impact on the area's big game populations.

5.3.3 Upland Game

Most species of upland game benefit from forest openings and from the vegetation that follows timber harvesting. It is quite likely that numbers of snowshoe hare, ptarmigan and grouse will increase following logging. This will have a positive impact on recreational opportunities in the area.

The increase in upland game following logging will also have a positive effect on pine marten since marten utilize these species as food. In fact, the anticipated increase in hare numbers may be particularly significant in view of the important position held by hares in the marten diets reported by Bateman (1982) and Snyder (1984, 1985). These investigators were studying marten in areas where cutovers were abundant, and the results seem to support Thompson's (1986) idea that marten can learn to use cutovers for effective hunting.

5.3.4 Furbearers (other than marten)

Most terrestrial fur species are generally quite adaptable to the moderate environmental disturbance caused by the incremental approach to timber harvesting proposed for Little Grand Lake. Red fox and lynx, probably the major furbearers in the study area, feed heavily on prey species (e.g. hares, grouse) which prefer the young successional habitats which will develop on cutovers.

Aquatic furbearer habitat would be threatened if no vegetation buffer zones were left along waterways. Siltation of water by eroding of banks, and by improper fording or construction activity in streams would have negative effects on such species as beaver and otter. However, such impacts are not anticipated at Little Grand Lake because buffer zones will be left, and stream crossings will be accomplished by following Department of Fisheries and Oceans guidelines.

Riparian areas are quite important for all furbearers. Di Bello (1982) reported that terrestrial as well as aquatic species show strong selection for habitat within a 100 m zone along waterways. A logging operation which retains a buffer zone around much of the water systems will not cause any major disturbance to furbearers or furbearer habitat. In fact, impact will be positive in some cases. Thompson (unpublished data) suggests that the overall effect of logging on lynx and red fox is positive; on otter, muskrat and beaver is neutral to positive. The impact on ermine is considered by Thompson to be negative.

In general, therefore, the impact of the proposed timber harvesting on furbearers will be neutral or positive. Most species may withdraw from the immediate area during road building or logging, but this would be a temporary action. Also, increased trapping pressure because of improved access is not a concern since the area is closed to trapping.

5.3.5 Raptors

The nesting habitat (mature conifer to open woodland areas) and the prey base (fish, small birds and rodents) required by the raptor species likely to be present in the study area (see Section 3.6.5) will not be significantly affected by logging. Half of the mature forest areas will remain uncut, and the prey base will likely increase in both diversity and numbers. Thus, while there could be some temporary abandoning of nest sites (the only known raptor nest is outside the study area) or other disturbance, no significant negative impact to raptors is anticipated at Little Grand Lake. This is consistent with the findings of Anderson (1985) who observed that raptor presence and wood harvesting operations can be compatible.

5.3.6 Waterfowl

The Long Range Barrens ecoregion habitat of the study area is not very productive for waterfowl (Goudie 1987). Based on the observations made during the field work carried out for other component studies (pine marten, steep slopes, historic resources), Goudie's theoretical breeding density for this ecoregion (65 breeding pairs per 100 km^2 of contributing water) does not appear to be achieved in the study area. While some waterfowl were observed, numbers did not appear to be high. In any event, approximately 75% of the contributing water in the study area consists of Little Grand Lake and Island Pond in the southern portion of the area. No logging activity will take place close to the shorelines of these water bodies.

The central and northern sections of the study area, in which nearly all of the road construction and timer harvesting will take place, provide little contributing water for waterfowl. Thus, little habitat and few birds would be adversely affected by the proposed logging and road building activity in these areas.

No dormitory camps or permanent equipment garage will be established in the study area. The volume of stored fuels will therefore be small, and strict adherence to fuel storage regulations will considerably reduce the potential for spills.

While there may be minor disturbance to a small number of breeding waterfowl, the proposed development is expected to have little, if any, negative impact on the amount of breeding habitat or on the number of waterfowl in the study area and in the region generally. Similarly, no significant increase in hunting pressure is anticipated as a result of improved road access because the roads are not accessing productive waterfowl habitat. Also, since dormitories are not being used, the potential for after-work harassment of any waterfowl that may be present is eliminated.

5.3.7 Fragmentation of Habitat

The study area presently supports an essentially continuous forest cover, with barrens and wetland openings occurring regularly throughout. More than 80% of this forest is mature and over-mature, and much of it is already heavily damaged by insects. The forest will change naturally to an immature forest cover over time. Even without logging, the forest in the study area will be in the 0 - 20 year old age class in about 20 years. The proposed logging is likely to accelerate the process. The medium to long-term effect of logging, therefore, will be to contribute to the alteration of the forest habitat.

However, in the short term (5-10 years) the logging operation will cause some fragmentation of the present mature and over-mature forest habitat. A consideration of the effects of fragmentation on wildlife resources in general, and on those resources at Little Grand Lake in particular, follows.

Generally speaking, both negative and positive impacts may result form habitat fragmentation. For species that require large areas of contiguous and similar habitat, fragmentation will have a negative impact. Each species (and individual) has a minimum habitat size requirement wherein it can meet al.l of its needs. When this minimum requirement cannot be met, the species (or individual) may be put at risk.

Fragmentation may also have a negative impact on wildlife in two other ways. Species that do not require large blocks of habitat may, nevertheless, be adversely affected if prevented from travelling readily from one area to another as may be required for particular biological functions (e.g. reproductive activity, or wide-ranging foraging/hunting). Secondly, species groups associated with block habitat conditions may loose some diversity if the area of the block decreases beyond a certain size. Thomas *et al.* (1979) reported on a number of studies (from the northwestern and north-eastern United States) that examined the relationship between stand size and species diversity in birds, and concluded that if the average stand size is between 30-40 ha, species richness attributable strictly to stand size should approach maximum. It's not possible, of course, to apply those figures directly to Newfoundland conditions. But the principle is important when considering habitat fragmentation, particularly when Thomas *et al.* (1979) suggest that bird species diversity and richness is assumed to be a reasonable indicator of the relationship of all vertebrate wildlife to stand size.

From another perspective, habitat fragmentation can have a positive impact because fragmentation creates edges: the well known "edge effect", whereby there is an increased richness of flora and fauna where two plant communities come together. Habitat richness is associated with the degree of contrast in vegetative structure along the edge; the greater the contrast, the greater the richness. The edges created by clear-cutting in mature and old growth forest represent the greatest possible degree of contrast in vegetation along the edge, and therefore the greatest amount of richness of animal species (Thomas *et al.* 1979).

The degree of habitat richness associated with a particular edge is also influenced by the size of the forest stand forming part of the edge. As mentioned above, there is a particular habitat block size that provides maximum wildlife diversity, and decreasing or increasing the size of that block will result in reduced diversity. Downsizing a larger block toward the optimum size will result in an increase in "edge" species of wildlife in response to the greater amount of edge. Moving in the opposite direction, enlarging a smaller block toward optimum size, creates less edge, and consequently the increase in wildlife diversity is due primarily to the addition of "non-edge" or "block habitat" species.

Depending on the particular region, and the wildlife species present in the region, the negative or the positive effects of fragmentation may be considered more important.

The Little Grand Lake area supports both "edge" (e.g. snowshoe hares, some small mammals, some raptors, grouse) and mature forest "block habitat" (e.g. marten, some raptors) species. In reality, the situation is somewhat more complex than that since each group generally uses the other habitat type for some purpose. For example, most "edge" species use the adjacent forest stands for thermal cover (cover used to ameliorate the effects of cold weather), and "block" species generally forage/hunt in the edge or in open habitat type. Thus, the availability of both blocks of mature timber and open/edge habitat can provide cover and foraging habitat for the wildlife species present at Little Grand Lake.

The major consideration is how will the various wildlife species (e.g. upland game, raptors, and marten) be affected by the short-term fragmentation of mature forest habitat at Little Grand Lake. An assessment of the impact of fragmentation on each wildlife group discussed in Sections 5.3.1-5.3.6 follows.

Except for caribou, the big game and upland game species present in the study area will benefit from fragmentation. No species requires large areas of contiguous mature forest habitat. And the availability of edges and regenerating clear cuts adjacent to uncut stands provide the forage and cover (including winter cover) requirements that will permit numbers of these species to increase.

For caribou, the study area does not represent important seasonal or migratory range. Fragmentation of forest habitat at Little Grand Lake is unlikely to have much of an effect one way or the other on caribou. If anything, the few caribou present may choose to use the roads and cutovers when moving through the area.

For furbearers (other than marten), fragmentation is likely to be mostly beneficial. The major fur species in the area (fox, lynx) prey on food species which prefer the vegetation provided in, and along the edge of, clear-cuts. The availability of hunting range adjacent to cover thus supplies the basic requirements of predatory fur species.

Aquatic furbearers are not expected to be negatively affected by habitat fragmentation since the commitment to leave vegetation buffer zone around waterways will override any possible negative impacts that fragmentation may otherwise have had.

The avifauna at Little Grand Lake will respond in a variety of ways to habitat fragmentation. Many birds (e.g. many songbirds, most owls and game birds, and many raptors) will continue to nest in the forest blocks remaining uncut, and will seek their food along the edge and/or in the open spaces, particularly as the open spaces (clear-cuts) regenerate. These species benefit from fragmentation. Some raptors (such as osprey and bald eagles) do not benefit from habitat fragmentation, but are not necessarily seriously affected by it, particularly if a vegetation buffer zone is left intact around watercourses, and if adequate nest sites remain undisturbed. Similarly, waterfowl are unlikely to be negatively affected if a buffer zone is left intact around lakes and ponds.

The species of most concern with respect to habitat fragmentation is the marten. As stated earlier (Section 5.3.1), the study area will not be able to support as many marten in the early years after logging as it can potentially support at present. However, the reduced number of marten that remain in the study area will be secure since the extensive stands of mature forest that remain uncut provide sufficient area for the establishment of territories for at least half the potential marten density possible at present.

The major threat posed by habitat fragmentation is, of course, that particular habitat blocks will become isolated, thus preventing the inward migration of individuals, or the exchange of members from one block to another. As mentioned above, this will not be the case for marten, or any other species, at Little Grand Lake. Because the forest stands that will be left uncut are extensive, marten will not be forced to occupy discontinuous range. And with the provision of sufficient travel corridors, general movement of marten from one stand to another remains possible.

It is possible, however, that long distance movement of marten (such as may occur in periods of prey scarcity) may be negatively affected by the presence of clear-cuts. Bissonette *et al.* (1988) documented movements of 30-40 km for some Little Grand Lake marten. Some of these animals had to cross barrens, other open areas, highways, transmission lines, and built-up areas in their travel. It is possible, therefore, that while inconveniencing long distance movement, habitat fragmentation may not prevent it.

5.4 HISTORIC RESOURCES

The field survey discovered no sites of archaeological importance, and concluded that the study area received little, if any, use by prehistoric or early historic people. While there do not appear to be any archaeological sites to consider in undertaking this development, attention will be paid to any terrain feature obviously not of natural origin; any such features will be immediately reported to the Historic Resources Division of the Department of Culture, Recreation and Youth.

5.5 RESOURCE USE

5.5.1 Fishing

No major increase in angling pressure is anticipated because of this development. The better fishing areas are presently accessible by road. Future road construction will not access fishing areas of any consequence.

It may be pointed out, however, that pristine trout populations are becoming rare, and catching trophy size fish may reduce the available and valuable genetic material.

5.5.2 Hunting

No significant additional harvests of waterfowl are anticipated as a result of this development because new access roads will open up areas with very little potential for waterfowl production. However, numbers of upland game (snowshoe hare, grouse) are expected to increase as a result of logging, and these species will be the focus of greater hunting activity. Similarity, moose numbers will likely increase in response to the early stages of vegetation succession on the cutovers. This will cause greater hunting activity for moose in the study area; road access has already resulted in greater numbers of moose harvested north of Little Grand Lake. Studies in Ontario have concluded that logging road access can be a factor in the decline of moose populations (Euler 1984). Provincial authorities should monitor closely the harvests from the Little Grand Lake area.

Some additional hunting pressure may be expected on caribou because of increased access, but this is not likely to result in a large increase in the number of animals killed. No critical range or seasonal concentrations of caribou are found in the study area. Logging activity will not increase the number of animals that use the area; in fact, the number of animals may be reduced. So, while more hunters may be present, the number of caribou will be about the same.

The commercial hunting camp located on Island Pond near the southern boundary of the study area is unlikely to be adversely effected by the timber harvesting operation. Logging is not proposed for the area near the camp. And, for the most part, guests from the camp hunt to the east of the study area. Also, little, if any, of the logging activity will be visible from the camp.

Thus, while the impact of the proposed development on hunting is likely to be mostly positive (increased game, better access), there are also negative connotations (potential for overhunting, illegal hunting and harassment). However, the latter can be controlled through annual quotas and enforcement.

5.5.3 Other Recreational

Such outdoor recreational pursuits as camping, skiing, boating etc. are not major activities in the study area. However, the proposed development will have a positive impact on these activities because of the improved road access. The impact is likely to be small because the area has limited potential for outdoor recreation.

5.5.4 Mineral Potential

Road access will have a positive effect on the level of mineral exploration and potential development in the study area.

5.6 SOCIAL/ECONOMIC

The proposed development will have a positive economic benefit for the residents of the region and for the province. Wood from the Little Grand Lake area will contribute to the continued operation of the mill at Corner Brook. A substantial local labour force of approximately 76 woods workers will be required by 1992. The annual woods payroll, including fringe benefits, for this project will be approximately $2,000,000. The total economic activity generated by the project will be $14,000,000 per year.

The workers can look forward to long term employment from the Little Grand Lake project. Also, to ensure a continuing supply of fibre from the area, a silviculture program of pre-commercial thinning and seedling planting will be initiated; this will create an additional 25 - 30 jobs.

5.7 AESTHETIC VALUES

Although the shorelines of Grand and Little Grand Lakes will not be cut, some sections of upper slopes visible from these waters (and visible from other locations in the area) will be harvested. Thus, from a strictly aesthetic perspective there will be some deterioration of aesthetic quality.

From the broader integrated aesthetic — wilderness — recreational perspective, there will be less impact since both the present wilderness and recreational values are limited.

5.8 RESIDUAL IMPACTS

This important aspect of the project is summarised below.

5.8.1 Steep Terrain

Terrain and soils at the sites required for access roads, extraction roads, and landings will be unavoidably altered; and these alterations to terrain and soil profiles will persist. These residual impacts are site-specific, of minor to medium magnitude, and long-term duration.

5.8.2 Fisheries Resources

Residual impacts include short-term (construction), minor, direct, sedimentation impact on riparian and stream habitat downstream of each crossing site. In addition, at the crossing site itself, the impacts will be site specific, minor to moderate magnitude, and of long-term (permanent) duration.

5.8.3 Wildlife Resources

Residual impacts on pine marten include habitat loss and alteration (negative, moderate to long-term, local); transient disturbance and displacement during cutting and road construction (negative, local, short-term); and, a potential for increase in numbers and variety of prey species (positive, local, medium to long-term).

For other wildlife species, residual impacts will be confined mostly to transient disturbance and displacement during periods of cutting and road construction (negative, local, minor, and short-term); loss of specific habitat such as wintering areas (moose) and nest sites (raptors) (negative, local, minor at Little Grand Lake, long-term); increased hunting pressure because of improved access (negative or positive, depending on perspective; local; moderate; and long-term); and, improved supply for such species as moose and most upland game (positive, local, moderate to major, and medium to long-term).

5.8.4 Historic Resources

No residual impacts are anticipated on historic resources. The study area is considered to have a low potential for historic resources.

5.8.5 Resource Use

The project is expected to have a positive residual impact on hunting, recreation, and mineral development (local, moderate, medium to long-term), and no residual impact of any significance on fishing.

5.8.6 Social/Economic

Because of the mix of tangible and intangible factors considered in socio-economic assessments, the concept of residual impact is difficult to apply. However, in general the project will have a positive residual effect in relation income and project-related job skills.

5.8.7 Aesthetics

Residual impacts will generally be negative, of moderate to high impact, regional in nature, and of moderate to long-term.

5.9 Summary of Impacts

The discussion of impacts presented above focused on the major components of the environment individually. To conclude this section the potential impacts of logging at Little Grand Lake will be summarized in a matrix format. Where possible, the matrix will also quantify the impact, and indicate whether the impact can be mitigated.

Using a matrix for such a wide ranging purpose as impact assessment can create difficulties. Although it has the advantage of being able to provide a very good overview, a matrix has limited capacity to qualify, and qualification is an important characteristic of impact assessment. However, when used strictly to consolidate and summarize information discussed elsewhere, a matrix can be a useful (if still somewhat restrictive) tool.

Three points should be noted in relation to this matrix (Figure 29):

- it is not a "general case" or "worse case" matrix; the impacts identified are those which could result from logging at Little Grand Lake over the 20-30 year length of the project;
- if a particular project activity can have both a negative and a positive impact, it is so indicated in the matrix;
- criteria for rating the impacts were discussed in Section 5 of this report. It is important to point out again that particular project activities (e.g. borrow pits, landings), while causing major impact at the site of activity, may actually result in minor impact in terms of the total study area. For example, the impact of landings is rated as minor since landings represent only 0.1% of the land base of the study area.

○ No Impact
◔ Negligible/Minor Impact
◕ Major Impact
P Positive Impact
◑ Moderate Impact
M Impact can be Mitigated in Whole or in Part

Project Activities	Environmental Components																				
	Physical				Biological												Human				
										Terrestrial Fauna											
	atmosphere	surface water	terrain/soils	aesthetics	aquatic habitat	aquatic biota	forest resource	forest as wildlife habitat	other wildlife habitat	raptors	water fowl	other avifauna	upland game	pine marten	other furbearers	big game	historic resources	fishing/hunting	other recreation	mineral development	economic
Road Construction/ Road Access	○	◔ M	◑ M	◔ M	◑ M	◔ M	◔ M	◔ P/M	◔ M	◔ M	◔ M	◔ P/M	◔ P/M	◔ M	◔ P/M	◔ P/M	○	P	P	P	P
Stream Crossing	○	◔ M	◔ M	◔ M	◑ M	◔ M	○	◔ M	◔ M	◔ M	◔ M	○	○	◔ M	◔ M	◔	○	P	P	P	P
Borrow pits	◔ M	◔ M	◔ M	◔ M	◔ M	◔ M	◔	◔ M	○	◔ M	◔ M	◔ P/M	P	◔ M	◔ M	◔	○	○	P	P	P
Cutting	○	◔ M	◔ M	◕ M	◔ M	◔ M	◕ M	○	◑ P/M	◔ M	◔ M	◔ P	P	◑ M	◔ P	◔ P/M	○	◔ P	◔ P	P	P
Forwarding	○	◔ M	◑ M	◑ M	◔ M	◔ M	○	○	◔ M	◔ M	◔ M	◔	◔ M	◑ M	◔	◔	○	○	○	○	P
Thinning	○	○	○	P	○	○	P	○	◔ M	○	○	◔ P	◔ P/M	◔ M	◔ P	◔ P	○	○	○	○	P
Landings	○	◔ M	◔ M	◔ M	◔ M	◔ M	◔ M	◔ M	◔ M	◔ M	◔ M	◔ M	◔ M	◔ M	◔ M	◔ M	○	○	○	○	P
Reforestation	○	P	P	P	P	P	P	○	○	○	○	○	◔ P	P	◔ P	◔ P	○	○	○	○	P
Fuel Storage	○	◔ M	◔ M	○	◔ M	◔ M	○	◔ M	◔ M	◔ M	◔ M	◔ M	◔ M	○	○	○	○	○	○	○	P

Figure 29: Summary of potential impacts of timber harvesting at Little Grand Lake

6.0 MITIGATIVE MEASURES AND RELATED INITIATIVES

6.1 INTRODUCTION

Generally speaking, mitigative measures are taken to counteract the adverse impacts which a development project may have on the environment; the reduction of impacts can range from 1 to 100 percent. In considering this question of mitigating environmental damage caused by development, Jahn (1979) concluded that mitigation may involve one or all of the following:

1. avoiding the adverse impact altogether by not taking a certain action or parts of an action,
2. minimizing impacts by limiting the degree or magnitude of the action and its implementation,
3. rectifying the impact by repairing, rehabilitating or restoring the affected environment,
4. reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action,
5. compensating for the impact by replacing or providing substitute resources or environments.

In the pine marten component study carried out by Bissonette *et al.* (1988), a mitigation scenario incorporating Jahn's first point is proposed: avoid the action, do not harvest timber. Although this is an idealistic and sometimes contradictory scenario, some concepts in it are legitimate and warrant comment before outlining practical mitigative measures for Little Grand Lake.

6.2 BISSONETTE SCENARIO

In this scenario it is proposed that the western part of the island be treated as an ecosystem and that a landscape scale management system be applied to it. The core area would include the Little Grand Lake study area but would be more than twice as large as the study area. No logging, trapping or snaring would be permitted within this core area. Surrounding the core area would be a second zone in which logging would be permitted if strict environmental guidelines were followed. Trapping and snaring would not be permitted in this second zone. Beyond the second zone would be an area of indeterminate size which, together with the core area and the second zone, would constitute the western ecosystem.

The landscape scale management decisions for the ecosystem would be made by a multi-disciplinary advisory board using Geographic Information System (GIS) methodology. GIS methodology employs remotely - sensed satellite information in an interactive computer format. Updated information on the state of the forest, state of wildlife habitat, state of the freshwater systems, availability of recreation areas etc. would be fed into the GIS. An operator sitting at a computer would determine the management options for a particular development project. For a timber harvesting operation for example, the operator would indicate where and how new harvesting (or salvage) will occur.

The GIS will likely become an important part of resource management in Newfoundland in the future. In forestry, wide-scale GIS application to management decisions as discussed by Bissonette *et al.* (1988) is probably a decade away. But it is important to understand that even when GIS is in regular use, its most important function will be to describe the land base and to identify problems and areas of resource conflict rather than to suggest any other mitigation option except "avoid the activity".

If such a system had been in place for this impact assessment, it would have provided various conflicting information to the resource managers. It would have targeted the extensive stands of insect-killed timber in the Little Grand Lake area for immediate salvage. But, had it been programmed with wildlife information (the present GIS uses airphotos for forest inventory, but contains no wildlife information) it would also have been aware that the pine marten inhabitated the area and would have identified the potential conflict between marten and forest harvesting. To resolve the conflict a field study, such as the one just completed, would be required. And, as pointed out earlier in this report, this field study (Bissonette *et al.* 1988) provided no evidence that marten would be displaced from the Little Grand Lake area by the proposed timber harvesting activities.

Furthermore, the Bissonette scenario ignores the broken nature of Newfoundland forests and assumes perfect access to all areas for forest management; the suggestion that there be widely dispersed cutovers and a minimum of roads is contradictory and unrealistic. Bissonette also assumes that the Little Grand Lake study area will forever remain prime pine marten habitat. This is unlikely to be the case; the insect damage which is quite widespread in the area will create an unfavourable habitat for marten. Preserving Little Grand Lake forests for marten may not achieve the desired long term objectives. Lane and Associates (1985) concluded that insect damage has caused serious negative impact to marten populations in Cape Breton; marten have abandoned areas of extensive insect-killed timber, or have undergone a drop in population. Lane also points out that logging can have a similar effect.

Thus, while GIS methodology as described by Bissonette *et al.* (1988) will likely be a feature of resource management in the future in Newfoundland, its adoption will only serve to identify the need for field studies such as has just been carried out for this EIS. And the potential impact of logging on the environment (on marten habitat in this particular case) will be judged on the results of field study, not on the identification of a conflict by the GIS.

Finally, the Bissonette scenario does not address possible mitigative measures for marten in the Little Grand Lake study area. Such an exercise was the purpose of this study. The regional concept proposed by Bissonette *et al.* (1988) is an idealistic one which does little to address the problem at hand. However, the recommendations proposed by Bissonette *et al.* (1988) for logging in the second zone will be taken into consideration when developing mitigative measures for the Little Grand Lake study area.

6.3 PROPOSED MITIGATION

The major potential impacts to the valued ecosystem components (marten, steep terrain, historic resources) and other components of the study area environment will come from harvesting and roads. These are the two project activities/features that can cause habitat disturbance and site deterioration, which are the impacts of greatest concern for all ecosystem components at Little Grand Lake. This section will therefore begin with a discussion of the mitigative measures which will be implemented for harvesting and roads in order to minimize site/habitat disturbance. These measures will address most of the concerns relative to marten, steep terrain and historic resources. However, some additional comment on mitigation for marten will be presented at the end of this section.

6.3.1 Harvesting

Harvesting Rotation

The proposed harvesting plan for Little Grand Lake calls for the annual harvest to be taken from a number of timber blocks scattered throughout the study area. Table 4 shows the harvesting plan for the first five years. This plan will result in different aged cutovers and different aged regeneration throughout the area. This, together with the presence of unharvested mature stands, will create a mix of various aged stands and open areas which will provide a variety of food sources and shelter favoured by most wildlife species. Marten can inhabit such areas successfully.

Size and Shape of Cutovers

No absolutes can be given in terms of size of clearcuts since many factors determine the size: terrain, distance, stocking, integrity of the stand, fire and/or insect damage are the more important considerations. In all likelihood, the actual acreage of the clearcut is less important than the distance between the forest edges. In the study area, topography and the presence of wetlands and unmerchantable timber associated with merchantable stands ensure that the distance between forest edges in most clearcuts will be less than 500 m.

In terms of shape, few (if any) clearcuts will be geometric. Merchantable stands in the study area are generally irregular in shape, and harvesting will follow this pattern as a matter of course. Clearcuts will therefore be irregular and more natural in shape. The amount of forest edge will be maximized, and this is beneficial to all wildlife species.

Travel Corridors and Buffer Zones

Figure 5 and Map 1 show the timber blocks proposed for harvest in the study area. Areas which will be left uncut are readily visible in the illustrations. All of these uncut areas are more than 100 m wide and greater than 15 ha in size. These areas will provide additional undisturbed habitat and travel pathways for marten and other wildlife throughout the study area. Where access roads cross these uncut areas, right of ways will be kept to the minimum required for construction of the road with adequate ditching and drainage to prevent erosion.

In addition to uncut areas of mature timber described above, buffer zones (minimum of 15 m and generally wider because of terrain or quality of timber) along and around waterbodies represent other natural travel pathways. Buffer zones will be left wide enough so that blowdown will be minimized. Where a good cover of ground vegetation occurs, the buffer zone can be narrower than where good ground vegetation is absent. On stream banks greater than 25% slope, the buffer zone will be maintained to the top of the bank and immediately beyond.

These corridors and buffer zones will serve not only as travel pathways and resident sites for marten and other wildlife, but will also represent potential wintering habitat for species such as moose. No other mitigative measures are likely to be necessary to protect wintering areas for moose. Numbers are not very high in the study area at present, and if the population does increase following logging, there are ample potential wintering sites in the approximately 50% of productive forest land not being harvested.

The buffer zones will, of course, be important to maintaining the integrity of fish habitat.

Raptor Nests

Project personnel should be made aware of the location of known nest sites, and no logging activity or construction work (e.g. roads) should be permitted within a 400 m radius of the site if breeding birds are present at the nest. The sensitive period for breeding raptors extends from late April/May to July. From August through late winter, project activities can resume. It has been shown that raptors and logging are compatible when forest management are planned and conducted with care (Anderson 1985).

Sensitive Terrain

Mitigation measures described here relate to the eight sites identified in the Stage 2 land system assessment as potentially sensitive to disturbance; Section 5.1.1 provides a description of each site.

Areas A and B: Much of these areas has been harvested already as part of the experimental procedure for the two year pine marten study (Bissonette *et al.* 1988). An evaluation of the impact to area A is reported earlier in this report. The buffer zone left around the wetland and stream appears to have been sufficient to prevent damage to these sensitive sites. Area B was not visited during this study, but harvesting techniques similar to those at area A were used at "B". Area C: A road was constructed across this area as part of the experimental harvesting program for the pine marten study. Proper drainage was maintained and no damage was apparent to the wetland which comprises the sensitive component of this site.

Area D: This area was determined to be sensitive on the basis of steep slope and proximity to a stream and lake. It has been determined by CBPPL that the slope at this particular site is excessive, and the site will not be harvested.

Area E: Most of this site is contained in a proposed travel corridor and therefore will not be harvested. Much of the non-corridor portion of the site is wetland, and will also not be harvested. Present plans call for an access road through this area. CBPPL commits to providing proper drainage for the road, and to leaving an adequate buffer zone of timber bordering the organic terrain.

Area F: CBPPL has determined that this is not a productive site, and little merchantable timber is available there. Consequently, the site will not be harvested.

Areas G and H: These areas are proposed for harvesting. Because of the presence of sensitive organic terrain at these sites, CBPPL commits to leaving an adequate buffer (minimum of 20 m) around the organics where no natural (i.e. unmerchantable timber) buffer exists.

Rehabilitation

Cut-over areas: CBPPL will monitor revegetation of all cut-over areas. It is expected that most cut-over areas will regenerate naturally to a second growth softwood forest. Productive sites not regenerating adequately will be scheduled for reforestation.

Skid trails and temporary extraction roads: These areas will be kept to a minimum in order to maintain the productive capacity of the forest land in the area. Where disturbance is such that productivity is reduced, these sites will be reforested. Usually direct seeding or planting in trails is successful. In extreme cases compacted soil may have to be mechanically loosened to provide a suitable site for seedling establishment and growth.

Landings: Pulpwood landings will be kept clear and reused as much as possible to reduce both the number and size of landings required. Landing areas greater than 0.4 ha in size on suitable sites will be re-seeded.

Support facilities: Major maintenance and fuel storage will be carried out at CBPPL's Camp 185, outside the study area. Where portable garages are set up on site, disturbance will be kept to a minimum. Disturbed areas greater than 0.4 ha in size on suitable sites will be re-seeded.

Pits and Quarries: It is not expected that significant pits or quarries will be required in the study area since most material required for forest access road construction can be obtained from the road right of way. Should pits or quarries be required they will be rehabilitated as required in permits issued for their establishment.

The buffer zones will, of course, be important to maintaining the integrity of fish habitat.

Aesthetics

Aesthetic considerations will not represent a very large part of harvest planning at Little Grand Lake. Visual impact within the study area (where vistas are enclosed) will be minimized by the irregular and natural shapes of the clearcuts. Viewing the study area from outside its boundaries (approaching it by vehicle for example) provides landscapes which are panoramic with no sense of boundary restrictions. The visual impact will therefore be greater from the outside looking in.

Concluding Comment

Most of the mitigative measures considered above relate to reducing the amount of habitat disturbance, with particular reference to marten. It is obvious, however, that habitat protection is of limited value (or of no value at all) without an adequate food base being present for the species at which the habitat protection measures are directed. Habitat protection will not remedy every situation. There will be further discussion of this point, as it relates to marten at Little Grand Lake, later in this report.

6.3.2 Roads

The Environmental Protection Plan (EPP) outlined in Section 6.5 of this EIS contains detailed guidelines to minimize the impact of roads in the study area. By way of general comment in this present section, it may be stated that the major factors incorporated in road design and construction relate to water courses and the fish resource, steep slopes, and wildlife resources.

Roads can proceed perpendicular to contours when the slope is less than 10%, and can move obliquely across contours (staying within 10% of the horizontal) up steeper slopes.

The number of stream crossings will be minimized, and the crossings will be perpendicular to the stream. This not only reduces the potential for damage to streams, but lowers cost as well. Bridges will be located at the narrowest point of the stream in so far as this is possible. Roads will not be located on the edges of watercourses. Sufficient room will be allowed between the road and the water to permit percolation of road surface runoff into the vegetation before it reaches the water. In addition, roads will avoid wetlands wherever possible. If roads must cross part of a wetlands, extraordinary precaution will be taken to ensure that disturbance is minimized.

6.3.3 Pine Marten Population Levels

The pine marten population level anticipated to be compatible with timber harvesting at Little Grand Lake is indicated earlier in this report. The mitigation measures described above, together with the proposed establishment of a marten reserve (see Section 6.4), are expected to be sufficient to maintain that population. But there are two major difficulties associated with the objective of maintaining this population level. First, it is difficult to be confident of making an early detection of change (including decline) in marten populations. Total counts for predators (particularly small predators such as marten) are not realistic because of their generally secretive nature. It is more common in species such as marten to estimate the size and well being of a population from indices (e.g. track counts), from recaptures of marked animals, or from a change in the sex and/or age ratio. However, most present-day techniques of estimation are not very precise, and only large changes in the population can be detected (Davis and Winstead 1980). Nevertheless, new variations of the basic methods for estimating population numbers are constantly being developed, and the on-going investigations of marten at Little Grand Lake can likely be counted on to provide an indication of marten population change in the study area.

The second difficulty lies in interpreting the reasons for any change in population. Can the change be attributed to the timber harvesting operation? Bissonette *et al.* (1988) found several causes for marten mortality at Little Grand Lake, including disease and predation. Also, long distance movement or abandonment of home range may be caused by any one of a number of factors. It is important, therefore, that the close relationship between CBPPL, the Department of Environment, and the on-going marten study at Little Grand Lake be maintained in order to co-operatively discover if logging-related activity is responsible for changes in marten population levels.

If it is shown by these on-going studies the marten population at Little Grand Lake has declined below anticipated levels, and that this decline can be attributed primarily to the timber harvesting operation (particularly habitat loss and alteration), than CBPPL will co-operate in seeking a mutually acceptable response to the problem. It will be necessary to consider the extent to which the reserve and travel corridors can be expected to arrest the decline, and how other mitigation strategies can effectively build on these areas. The precise nature of the mitigative action to be taken will reflect the known status and geographic distribution of Little Grand Lake marten at the time, but possible actions include additional travel corridors, leaving clumps of uncut timber in larger clear-cuts, and modifying the shape of clear-cuts in particularly important marten areas.

6.4 PINE MARTEN RESERVE

As Bissonette *et al.* (1988) pointed out, reserves have been used elsewhere as a management strategy to assist in maintaining populations of carnivores, including marten. It is quite probable that the Newfoundland pine marten would benefit from the establishment of a reserve although there is no evidence that the Little Grand Lake area (which has remained essentially undisturbed for a number of years) has fulfilled this function in the past. To be successful, a reserve should provide for adequate recruitment within its borders, and permit dispersing marten to find suitable habitat immediately outside. In addition, a reserve should be large enough to accommodate a number of home ranges of the target species, although the precise number of home ranges is open to question.

CBPPL commits to leave in excess of 100 km^2 of land undeveloped in the Little Grand Lake study area: a 100 km^2 block (encompassing most of Little Grand Lake) in the southern part of the study area (Licence Lot 38), and two large east-west migration corridors (totalling approximately 10 km^2) along major waterways flowing into Grand Lake in the northern part (L.L. 127) (Figure 30). In addition, the Company also will commit to leave in its present state its holdings of approximately 100 km^2 on Glover Island (Reid Lot 223). The commitment of land in the study area and on Glover Island represents the Company's contribution to a pine marten reserve should the Province elect to create such a reserve in the area in the future. These lands, particularly the lands within the study area, together with adjacent Crown Land would appear to be able to provide a suitable reserve for the pine marten. Approximately 50% of the committed lands within the study area supports mature and over-mature forest. Also, the 100 km^2 around Little Grand Lake lies adjacent to, and may contain portions of the home ranges of some marten radio collared by Bissonette *et al.*. (1988).

Because the total area of Company freehold land in Newfoundland must not change as a result of this reserve, CBPPL proposes that, if the reserve is established, the committed freehold land be replaced with freehold title to an equivalent area of Company licenced land in western Newfoundland. The suggested area for this exchange of land title is the portion of L.L. 7 and L.L. 34 indicated in Figure 31.

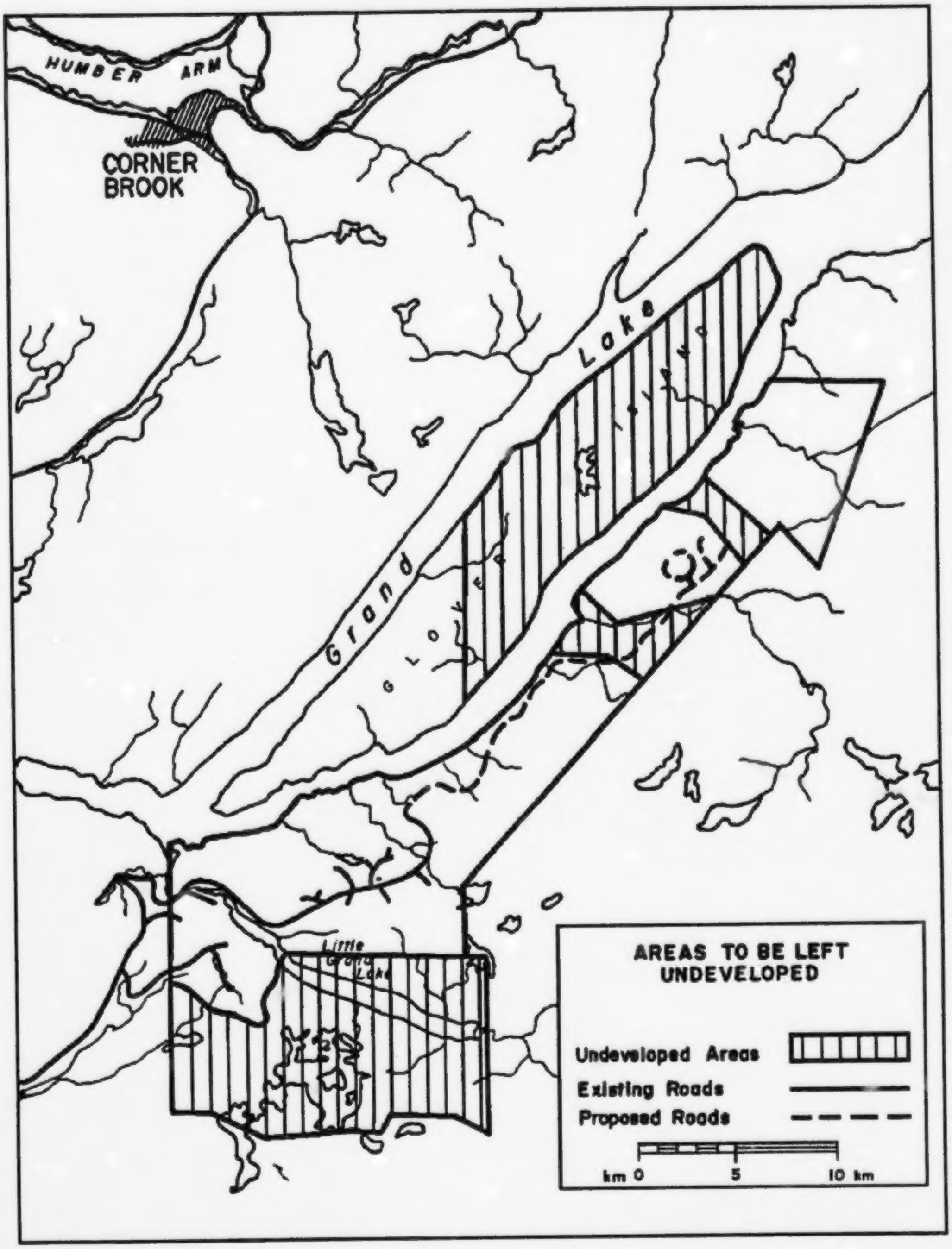

HUMBER ARM
CORNER BROOK
Grand Lake
GLOVER
Little Grand Lake
AREAS TO BE LEFT UNDEVELOPED
Undeveloped Areas
Existing Roads
Proposed Roads
km 0
5
10 km

Figure 30

Areas to be left undeveloped

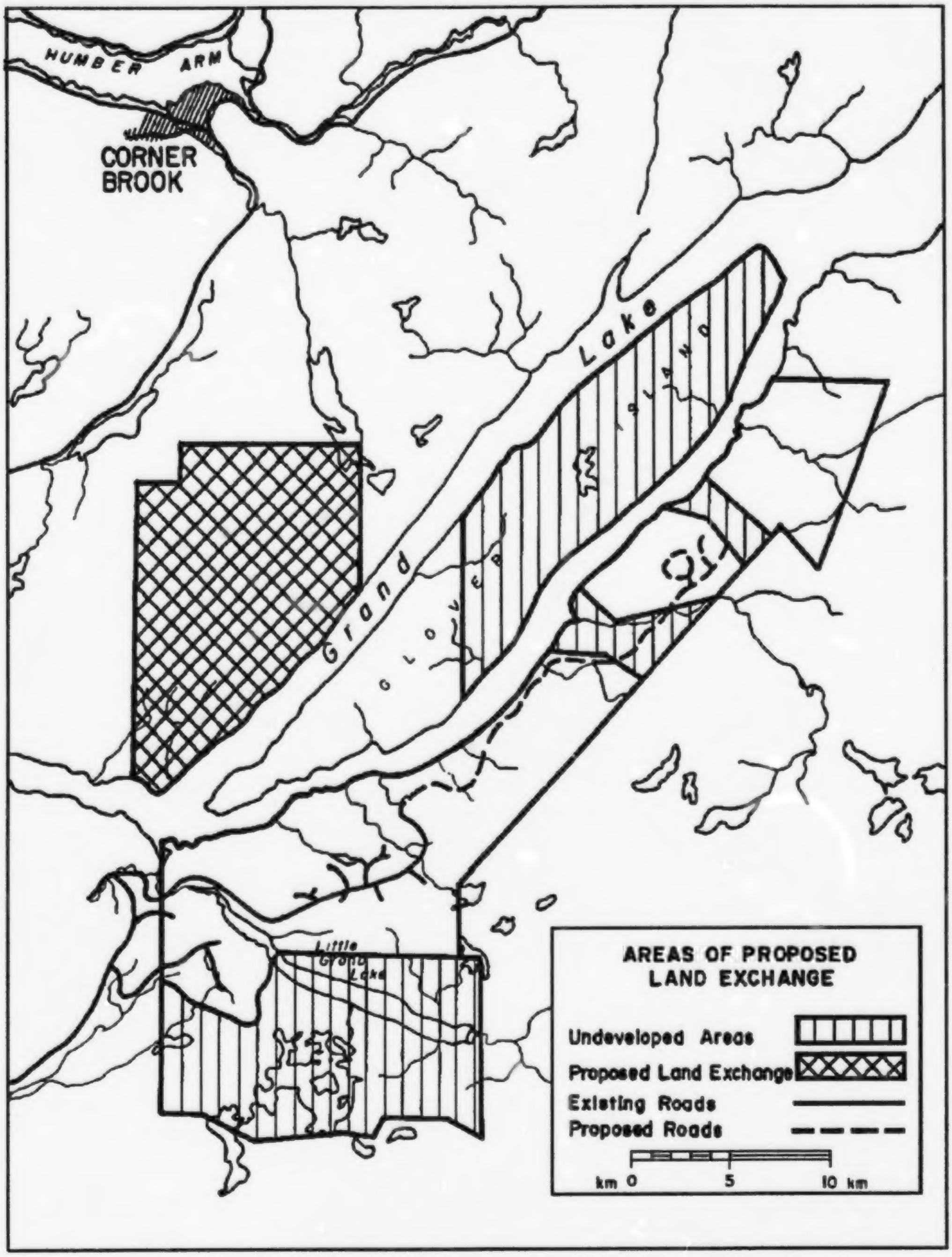

HUMBER ARM
CORNER BROOK
Grand Lake
GLOVER ISLAND
Little Grand Lake
AREAS OF PROPOSED LAND EXCHANGE
Undeveloped Areas
Proposed Land Exchange
Existing Roads
Proposed Roads
km 0
5
10 km

Figure 31

Areas of proposed land exchange

6.5 PINE MARTEN FOOD BASE

An adequate food base is as important as the availability of mature conifer habitat to the survival of marten in Newfoundland. While the meadow vole (*Microtus pennsylvanicus*), the major food item in the marten diet at Little Grand Lake (Bissonette *et al.* 1988), inhabits a variety of habitats in Newfoundland, it is not abundant in forested areas (Folinsbee *et al.* 1973). CBPPL therefore, suggests that the Newfoundland Wildlife Division consider enhancing the marten food base by introducing the red backed vole (*Clethrionomys gapperi*), a species which has previously been experimentally introduced to a number of islands in Notre Dame Bay. This species, which is a true inhabitant of forested areas, would provide an enhanced food base not only for marten but for other mammalian predators and for raptors as well.

CBPPL would commit to participation in a pilot introduction of red backed voles in the Little Grand Lake area. Glover Island appears to be a suitable site for such a pilot project, and CBPPL would agree in principle with the use of its holdings there for such a purpose.

CBPPL will also agree in principle with participation (with the Wildlife Division) in a captive breeding program for marten, the intention of such a program being to release marten into the wild. Northland Associates Ltd. has discussed this matter with an individual (presently residing in Ontario) who has successfully bred marten captured from the wild, and the prospects for such a program appear to be promising.

6.6 ENVIRONMENTAL PROTECTION PLAN

This plan has been developed to ensure that the proposed forest harvesting operations and construction of forest access roads shall conform to all current Legislation, and to provide for procedures to mitigate any potential negative impacts of the proposed development on the environment.

1. Road Construction

a) Right of Way Clearing

Cutting and removal of trees and brush.

- Merchantable trees will be harvested from R.O.W.
- Right of way width at water crossings should be narrowed to the width of the base of the road at the crossing. Both sides of the crossing shall be well flagged to show this width reduction. The removal of trees and other vegetation shall be restricted to this narrowed section.
- Trees and vegetation at water crossings shall be cleared by hand.
- Equipment activity at water crossings shall be minimal.
- Dangerous trees or snags that may later fall across the road shall be removed during the R.O.W.clearing.

b) Subgrade Construction

- Before beginning construction, verify the road centre line and determine the specifications and standards required.
- Keep cuts and fills to a minimum in areas of unstable soil.
- On slopes containing loose material, keep uphill cuts to a minimum — fill the downhill side instead.
- When working near sensitive areas such as streams or lakes, suspend any road building operation causing erosion or siltation during periods of intensive rainfall or when soils are saturated.
- Avoid unnecessary side casting or backfilling specially in the vicinity of waterways. Where geographical constraints dictate that the roadbed must be constructed adjacent to a watercourse, road slope stabilization may be required at the toe of fill where it enters water (where active erosion is likely). The placement of large riprap or armour stone is recommended in such areas.
- Fill unstable areas with gravel, rock or other suitable material.
- Locate ditches far enough away from the road so that water will not seep under the road surface to soften the subgrade.
- Do not remove gravel fill from any water course or within the active flood plain.

c) Road Drainage

- Construct adequate ditches and incorporate them at the time of subgrade construction.
- Keep ditches at the same gradient as the road.
- In sidehill and similar areas, install ditches on the uphill sides of roads to intercept seepage and runoff.
- On flat gradients, outslope roads 2 cm/m to 3 cm/m to effectively remove small quantities of water from the road surface.
- On steep gradients, crown road 2 cm/m and spread the berm to ensure that the surface will drain.
- Prevent ditch flow into streams by constructing ditch runouts or takeoff ditches on road approaches a minimum of 30 m from streams.
- Road construction into wetland areas requires special techniques because of high water table levels.

Subsurface flow in peatlands is substantial, even when gradients are minimal. After construction, road beds undergo compaction and act as barriers to subsurface drainage, raising water table levels and causing permanent or temporary flooding on uphill sides of roads.

- Place culverts at ditch elevation to prevent the impoundment of water.
- Place culverts to maintain drainage in areas where deep fills are required.
- Frequently divert ditch flows into culverts to prevent erosion or overflow.
- On steep roads, angle the culvert across the road so that water will flow through readily.

d) Stream Crossings (general)

- Use bridges or culverts when crossing all watercourses.
- Where possible, crossings should be at right angles to streams.
- Install bridges at watercourse crossing where stream flows exceed 8.5 m^3/sec (300 ft^3/sec).
- Construct the approaches to stream crossings with erosion-resistant materials, such as rock or gravel. Approaches should have the same slope as the road for at least 15 metres on each side of the watercourse.
- Avoid known fish spawning, rearing, feeding or overwintering areas as suitable crossing sites. If this is unavoidable, the use of a bridge with a high approach rather than a culvert should be specified to limit disturbance to the channel. To avoid silt deposition on the spawning area, the site should be selected at least 500 m (1,600 ft.) downstream from the critical areas with adequate provision for safe passage of fish.
- Select crossing sites as far upstream from a river mouth or as far downstream from a lake outlet as possible. River mouths and lake outlet areas are favoured habitats for fish spawning and feeding or are locations through which fish movements are heavy. Crossings should not be placed within 500 m (1,600 ft.)of them. The crossing at braided portions of a stream should be avoided, otherwise extensive flooding, stream siltation, or failure of the crossing may occur.
- Where natural barriers to fish passage, such as waterfalls, exist, the crossing, where possible, should be selected upstream of the barrier where fish passage would not be affected by bridge or culvert installations.
- Conduct heavy equipment work at stream crossings according to the following criteria:

    Restrict crossing to a single location and cross at right angles to the stream;

    Minimize equipment activity within the wetted perimeter of the stream. All construction equipment should be mechanically sound to avoid leaks of oil, gasoline and hydraulic fluids;

    Do not service or wash heavy equipment adjacent to watercourses. Remove from site and properly dispose of all waste oil, filters, containers or other site debris;

    Use corduroy and brushmats to stabilize approaches to temporary crossing areas, however, ensure that these are removed upon project completion;

Ford streams only where the stream bottom is stable, such as in bedrock or cobble areas. Return crossings to their original condition when construction has been completed;

Any materials placed in the stream to improve the crossing site should be clean, non-erodible and non-toxic to aquatic life. Where stream flows permit, maintain a minimum of 20 cm of water at the crossing site at all times;

Install permanent stream crossing structures as soon as possible, preferably during sub-grade construction.

- If blasting is required in or near fish habitat during stream crossing construction of resource road building, the following criteria should apply:

  Consult the Department of Fisheries and Oceans first before any blasting is undertaken near fish habitat;

  Do not undertake any blasting within 400 m of known fish spawning grounds when eggs or alevins are still in the gravel;

  Reduce the area of high blast concussion with special detonation techniques, by reducing the shot charge, or by using mats or blast deflectors.

- An adequate supply of filter fabric shall be maintained on site and be deployed on an "as needed" basis, to control siltation from site runoff. This material shall be contained within a rigid 2" x 4" wood frame, with winged containment walls.
- In all cases where site conditions permit, the ground vegetation between the road and a waterway should not be grubbed or disturbed in any way.
- Where it is deemed necessary, at the outfall of all cross-road drainage pipes, settling or catch basins will be constructed to ensure that sediment laden runoff water can filter out suspended solids before entering a sensitive waterbody or stream. A maintenance program will be provided to ensure continuity of this procedure.

e) Culverts

- Culverts will be designed to adequately carry peak flows from drainage areas giving consideration to culvert capacity and estimated peak flows.
- Where fish passage is required, the minimum culvert diameter will be 1000 mm.
- Culverts will be installed so that the culvert bottom is below the natural streambed level a minimum of 300 mm or 1/3 the diameter of the culvert, whichever is less.
- Culvert outlets will be lined with coarse material to prevent erosion and potential free fall.
- Culvert inlets and outlets will be riprapped to prevent erosion of fill slopes.
- Fill material will be compacted around the culvert and to a depth above the culvert equal to at least one half the culvert diameter but not less than 45 cm.
- Culverts will be aligned along the original direction of stream-flow.
- Backfill material will not be taken from stream beds or banks.
- Structural supports will be removed from culverts after the road bed has settled.
- When excavating for culverts, coffer dams of non-erodible material will be used to separate work areas from the stream.
- Water pumped from coffer dams will be directed into adjacent vegetation so that it can filter through before re-entering the stream.
- Upon completion of construction, coffer dams will be removed and the streambed returned to its original condition.

f) Bridges

Bridge Design Criteria

- Bridge crossings are the preferred structural type of stream crossing for streams supporting any anadromous (searun) fish populations. A well designed bridge allows for a natural stream bottom at a crossing site and does not result in any increased water velocities which may impede fish passage or cause downstream streambed scour.

- Bridge embankments will not constrict a stream channel by more than 1/3 the channel width.
- Whenever possible, bridge abutments will be constructed above the normal wetted perimeter of the stream. Instream piers will be aligned with the stream flow.
- To prevent approach erosion, bank slumping, and potential structural failure, bridge decking will be constructed at an elevation that will permit free passage of water and ice during periods of peak flow and ice breakup. Major road bridges will have a 1 m clearance to avoid debris or ice buildup.
- Where possible, bridges will be located on straight sections of a stream, where the stream channel is narrow, having low banks and firm non-erodible soils.
- Bridges will be aligned so as not to direct flow into the banks. If this is unavoidable, then bank protection will be provided.
- Bridges will be equipped with wingwalls to prevent bank erosion and slumping of the roadbed.

Bridge Construction

Construct bridges using the following criteria:

- Backfill material must be end hauled and not removed from stream beds or banks (riparian areas).
- Minimize and restrict the use of heavy equipment in watercourses. Use a rubber-tired backhoe from shore rather than a bulldozer in the stream whenever possible, and ensure all heavy equipment is mechanically sound to avoid leaks of oil, gas or hydraulic fluid.
- Carry out excavation for piers, footings, and abutments in such a manner as to keep the work area separated from the stream.
- Water pumped from coffer dams will be directed into adjacent vegetation so that it can filter through before re-entering the stream.
- Coffer dams constructed of sand bags will be used to separate work areas from streams and coffer dams will be of sufficient height and strength to handle anticipated fluctuations in the level of the watercourse in question;
- Construction activities will not block more than 1/3 of the stream width at any one time;
- Upon completion of construction coffer dams will be removed and the streambed returned to its original condition;
- Lime, cement or fresh concrete will not be permitted to enter waterways;
- Where on-site application of wood preservative to bridge timbers is required, it will be done a minimum of 15 metres from the nearest water body and treated materials will be allowed to dry completely before being used in or near any waterbody;
- Upon completion of construction, all construction debris will be removed from the stream and adjacent area and properly disposed of.
- Abutments shall be built on dry land.
- There will be no narrowing of the river.
- The placement of excavated material will be planned to leave the finished site in a pleasing condition.
- Concrete placement will be according to proven safe practice, whereby displaced water is pumped onto a drainage strip, to ensure that no cement gets into the stream.
- There will be no bulldozing of the bridge abutments, as excavation will be by backhoe.
- Bridge approaches will be filled with borrow material.

2. Forest Harvesting

a) Felling

- Trees will be felled so that no tops or slash enter any waterbody. Any tops or slash inadvertently falling into waterbodies will be immediately removed.
- Good utilization will be practiced avoiding large tops and high stumps.

b) Skidding/Forwarding

- Skid trails and extraction roads will be located along contours rather than perpendicular to the contour.
- The number of bulldozed skid trails will be kept to a minimum.
- Stream beds will not be used as skid trails. Bogs and other sensitive wetland areas will be avoided.
- Wide tires can reduce ground disturbance on steep terrain and in soft ground conditions. These will be used where required to avoid unnecessary disturbance.

c) Landings

- Landing sites will be kept to a minimum in both size and number. Wherever possible landing sites will be reused in order to avoid additional site disturbance.
- Bulldozed landings greater than 0.4 ha in size on suitable sites will be reforested by planting or direct seeding.

3. Wildlife Areas

a) Blasting or excessive use of heavy machinery will not be undertaken within 400 m of known raptor nest sites or important waterfowl breeding areas if such locations are occupied by breeding birds.

b) Roads will avoid, wherever possible, going through known moose wintering yards.

c) Roads that cross known wildlife (e.g. moose, caribou) crossing areas will facilitate the continued use of such areas by bulldozing earth ramps at these locations.

4. Archaeological Sites

a) Any structure or formation which could conceal evidence of archaeological importance will be avoided, and reported to Archaeology Division of the Department of Culture, Recreation and Youth.

5. Support Facilities

a) Maintenance facilities such as garages will be located so that fuel and lubricants cannot enter any water body. The maintenance and repair of construction equipment should, as much as possible, be carried out in appropriate locations set aside for these purposes. Temporary installations must be provided with devices for recovery of used lubricants.

b) Locate fuel tanks a minimum of 100 m from any water body or marsh areas, and construct impermeable dykes so that any spillage is contained, or use newer model self-contained oil tanks (GEEP tanks). Any accidental spill of lubrication oil, diesel fuel, gasoline or any other hydrocarbon should be immediately reported to the appropriate authorities.

a) Disposal of lunch refuse. All lunching will be done at designated, controlled areas, where garbage containers will be provided. All personnel will use these containers and Corner Brook Pulp and Paper Limited will ensure that the contents are removed on a regular basis, and disposed of in a designated, environmentally approved disposal site.

b) Gasoline and chain oil containers for power saws. All containers will be brought to the lunch area for disposal into the garbage containers.

6. Contingency Plan to Mitigate an Oil Spill

The use of machinery, as we construct a forest access road, presents an exposure to a potential oil spill (diesel fuel). The exposure consists of various combinations of the following mobile machines:

Backhoe

Air-track drills complete with air compressor

Fuel tanks

Tractor-dozers

Front end, rubber-tired shovel

100 HP class rubber-tired skidder.

The exposure to an oil spill could come from:

1. A fuel leak in one of the machines, or in a fuel tank.

2. A mobile machine rolls over, and ends up in a stream or water body.

For item 1, correction will be as follows:

a) Correct the leak (for a minor leak).

b) If the leak is serious, then the area around the machines should be dyked, and then the ponded fuel pumped into 45 gallon oil drums for disposal. After pumping the ponded fuel, the contaminated dyke material will be removed and be disposed of in an approved dumping area.

For item 2, correction is as follows:

a) First determine if fuel oil or hydraulic oil is leaking out of their respective tanks into the river. If so, immediately position a section of oil boom downstream of the machine.

b) Pump the tank contents into 45 gallon oil drums.

c) Remove the machine as expeditiously as possible.

d) Remove the ponded oil or fuel from the boom catchment area, and then remove the boom.

Materials and equipment required to adequately cope with the above:

Wajax fire pump and 300 feet of hose.

2 hand-operated fuel pumps.

6 45 gallon oil drums.

4 long-handled shovels.

2 pick axes.

15 yards of impervious soil (a silt or clay bearing gravel).

1 roll of oil-sorbent material.

4 bags of peat moss (oil sorbent).

1 section of oil boom.

This plan has been developed to ensure that the construction of forest access roads shall conform to all current legislation, and to provide for procedures of design and construction to mitigate the impact on streams and surrounding areas, and on all areas of forest land exposed to road construction procedures.

1. Cutting of R.O.W.

a) Disposal of lunch refuse.

All lunching will be done at designated, controlled areas, where garbage containers will be provided. All personnel will use these containers and Corner Brook Pulp and Paper Limited will ensure that the contents are removed on a regular basis, and disposed of in a designated, environmentally approved disposal site.

b) Gasoline and chain oil containers for power saws.

All containers will be brought to the lunch area for disposal into the garbage containers.

c) Cutting and removal of trees and brush.

- Merchantable trees will be harvested from R.O.W.
- Right of way width at water crossings should be narrowed to the width of the base of the road at the crossing. Both sides of the crossing shall be well flagged to show this width reduction. The removal of trees and other vegetation shall be restricted to this narrowed section.
- Trees and vegetation at water crossings shall be cleared by hand.
- Equipment activity at water crossings shall be minimal.

Dangerous trees or snags that may later fall across the road shall be removed during the R.O.W. clearing.

2. Subgrade Construction

a) Before beginning construction, verify the road centre line and determine the specifications and standards required.

b) Keep cuts and fills to a minimum in areas of unstable soil.

c) On slopes containing loose material, keep uphill cuts to a minimum — fill the downhill side instead.

d) When working near sensitive areas such as streams or lakes, suspend any road building operation causing erosion or siltation during periods of intensive rainfall or when soils are saturated.

e) Avoid unnecessary side casting or backfilling especially in the vicinity of waterways. Where geographical constraints dictate that the roadbed must be constructed adjacent to a watercourse, road slope stabilization may be required at the toe of fill where it enters water (where active erosion is likely). The placement of large riprap or armour stone is recommended in such areas.

f) Fill unstable areas with gravel, rock or other suitable material.

g) Locate ditches far enough away from the road so that water will not seep under the road surface to soften the subgrade.

h) Do not remove gravel fill from any water course or within the active flood plain.

3. Stream Crossings

a) Use bridges or culverts when crossing all watercourses. Where possible, crossings should be at right angles to streams.

b) Install bridges at watercourse crossing where stream flows exceed 8.5 m^3/sec (300 ft^3/sec).

c) Construct the approaches to stream crossings with erosion resistant materials, such as rock or gravel. Approaches should have the same slope as the road for at least 15 metres on each side of the watercourse.

d) Avoid known fish spawning, rearing, feeding or overwintering areas as suitable crossing sites. If this is unavoidable, the use of a bridge with a high approach rather than a culvert should be specified to limit disturbance to the channel. To avoid silt deposition on the spawning area, the site should be selected at least 500 m (1,600 ft.) downstream from the critical areas with adequate provision for safe passage of fish.

e) Select crossing sites as far upstream from a river mouth or as far downstream from a lake outlet as possible. River mouths and lake outlet areas are favoured habitats for fish spawning and feeding or are locations through which fish movements are heavy. Crossings should not be placed within 500 m (1,600 ft.) of them. The crossing at braided portions of a stream should be avoided, otherwise extensive flooding, stream siltation, or failure of the crossing may occur.

f) Where natural barriers to fish passage, such as waterfalls, exist, the crossing, where possible, should be selected upstream of the barrier where fish passage would not be affected by bridge or culvert installations.

g) Conduct heavy equipment work at stream crossings according to the following criteria:

- Restrict crossing to a single location and cross at right angles to the stream;
- Minimize equipment activity within the wetted perimeter of the stream. All construction equipment should be mechanically sound to avoid leaks of oil, gasoline and hydraulic fluids;
- Do not service or wash heavy equipment adjacent to watercourses. Remove from site and properly dispose of all waste oil, filters, containers or other site debris;
- Use corduroy and brushmats to stabilize approaches to temporary crossing areas, however, ensure that these are removed upon project completion;
- Ford streams only where the stream bottom is stable, such as in bedrock or cobble areas. Return crossings to their original condition when construction has been completed;
- Any materials placed in the stream to improve the crossing site should be clean non-erodible and non-toxic to aquatic life. Where stream flows permit, maintain a minimum of 20 cm of water at the crossing site at all times;
- Install permanent stream crossing structures as soon as possible preferably during subgrade construction.

h) If blasting is required in or near fish habitat during stream crossing construction of resource road building, the following criteria should apply:

- Consult the Department of Fisheries and Oceans first before any blasting is undertaken near fish habitat.
- Do not undertake any blasting within 400 m of known fish spawning grounds when eggs or alevins are still in the gravel;
- Reduce the area of high blast concussion with special detonation techniques, by reducing the shot charge, or by using mats or blat deflectors.

4. Wildlife Areas

a) Blasting or excessive use of heavy machinery will not be undertaken within 400 m of known raptor nest sites or important waterfowl breeding areas if such locations are occupied by breeding birds.

b) Roads will avoid wherever possible going through known moose wintering yards.

c) Roads that cross known wildlife (e.g. moose, caribou) crossing areas will facilitate the continued use of such areas by bulldozing earth ramps at these locations.

5. Archaeological Sites

a) Any structure or formation which could conceal evidence of archaeological importance will be avoided, and reported to Archaeology Division of the Department of Culture, Recreation and Youth.

6. Road Drainage

a) Construct adequate ditches and incorporate them at the time of subgrade construction.

b) Keep ditches at the same gradient as the road.

c) In sidehill and similar areas, install ditches on the uphill sides of roads to intercept seepage and runoff.

d) On flat gradients, outslope roads 2 cm/m to 3 cm/m to effectively remove small quantities of water from the road surface.

e) On steep gradients, crown road 2 cm/m and spread the berm to ensure that the surface will drain.

f) Prevent ditch flow into streams by constructing ditch runouts or takeoff ditches on road approaches a minimum of 30 m from streams.

g) Road construction into wetland areas requires special techniques because of high water table levels. Subsurface flow in peatlands is substantial, even when gradients are minimal. After construction, road beds undergo compaction and act as barriers to subsurface drainage, raising water table levels and causing permanent or temporary flooding on uphill sides of roads.

h) Place culverts at ditch elevation to prevent the impoundment of water.

i) Place culverts to maintain drainage in areas where deep fills are required.

j) Frequently divert ditch flows into culverts to prevent erosion or overflow.

k) On steep roads, angle the culvert across the road so that water will flow through readily.

7. Bridges

a) Bridge Design Criteria

- Bridge crossings are the preferred structural type of stream crossing for streams supporting any anadromous (searun) fish populations. A well designed bridge allows for a natural stream bottom at a crossing site and does not result in any increased water velocities which may impede fish passage or cause downstream streambed scour.
- Bridge embankments should not constrict a stream channel by more than 1/3 the diameter of that channel width.
- Whenever possible, bridge abutments should be constructed above the normal wetted perimeter of the stream. Instream piers should be aligned with the stream flow.
- To prevent approach erosion, bank slumping, and potential structural failure, bridge decking should be designed at an elevation that will permit free passage of water and ice during periods of peak flow and ice breakup. Major road bridges should have a 1 m clearance to avoid debris or ice buildup. Bridge designers of forest resource roads should also take into account effects of changes in the drainage basin due to forest harvesting operations such as clear cutting.
- Construction of concrete aprons under bridges is not recommended as such structures may block fish passage at low flows.
- Bridges should be located on straight sections of a stream, where the stream channel is narrow, having low banks and firm non-erodible soils.
- Bridges should be aligned so as not to direct flow into the banks. If this is unavoidable, then bank protection should be provided.
- Bridges should be equipped with wingwalls to prevent bank erosion and slumping of the roadbed.
- The installation of any bridge structure requires prior authorization from the Department of Fisheries and Oceans, as well as from the Newfoundland Department of Environment and Lands.

8. Bridge Construction

a) Construct bridges using the following criteria:

- Backfill material must be end hauled and not removed from stream beds or banks (riparian areas);
- Minimize and restrict the use of heavy equipment in watercourses. Use a rubber-tired backhoe from shore rather than a bulldozer in the stream whenever possible, and ensure all heavy equipment is mechanically sound to avoid leaks of oil, gas or hydraulic fluid;
- Carry out excavation for piers, footings, and abutments in such a manner as to keep the work area separated from the stream;
- If pumping of water from the excavation is required, it should be carried out so that water from coffer dams is either pumped into a settling pond, or alternatively filter fabric dam, or into an adjacent vegetated area where it can filter through before re-entering the stream. This allows sediment to settle out of the pumpout water. The maximum allowable limit of total suspended solids from a construction site that is permitted to be discharged into a watercourse or waterbody is 30 mg/l over the background total suspended solids levels (Nfld. Department of Environment — *Environment Control Regulations 1980*). Siltation can be quite harmful to aquatic life;
- Coffer dams constructed of sand bags shall be used to separate work areas from streams and ensure that coffer dam is of sufficient height and strength to handle anticipated water level fluctuations in the watercourse in question;
- Do not block more than 1/3 of the stream width at any one time;
- Remove coffer dams upon completion of construction and return the streambed to its original condition;
- Prevent the entry of lime, cement or fresh concrete into waterways;
- Ensure that wood preservative-treated lumber or materials are completely dry before use in and near any water body. The use of pretreated timber is preferred from an environmental standpoint, however, if on site application of any wood preservative to bridge timber is necessary, it should be done a minimum of 15 metres from the nearest water body;
- Remove all construction debris from the stream and adjacent stream area and dispose of it by burning (if local regulations allow) or by transporting such waste materials to the nearest environmentally approved waste disposal site. Remove excess excavated material from the immediate area so that heavy rains or high stream flows will not return them to the stream.
- Abutments shall be built on dry land.
- There will be no narrowing of the river.
- The placement of excavated material will be planned to leave the finished site in a pleasing condition.
- Concrete placement will be according to proven safe practice, whereby displaced water is pumped onto a drainage strip, to ensure that no cement gets into the river.
- There will be no bulldozing of the bridge abutments, as excavation will be by backhoe.
- Bridge approaches will be filled with borrow material.

9. Support Facilities

a)Locate maintenance facilities such as garages so that fuel and lubricants cannot enter any water body. The maintenance and repair of construction equipment should, as much as possible, be carried out in appropriate locations set aside for these purposes. Temporary installations must be provided with devices for recovery of used lubricants.

b) Locate fuel tanks a minimum of 100 m from any water body or marsh areas, and construct impermeable dykes so that any spillage is contained, or use newer model self contained oil tanks (GEEP tanks). Any accidental spill of lubrication oil, diesel fuel, gasoline or any other hydrocarbon should be immediately reported to the appropriate authorities.

General

1. An adequate supply of filter fabric shall be maintained on site and be deployed on an "as

needed" basis, to control siltation from site runoff. This material shall be contained within a rigid 2" x 4" wood frame, with winged containment walls.

2. In all cases where site conditions permit, the ground vegetation between the road and a waterway should not be grubbed or disturbed in any way.

3. Where it is deemed necessary, at the outfall of all cross-road drainage pipes, settling or catch basins will be constructed to ensure that sediment laden runoff water can filter out suspended solids before entering a sensitive waterbody or stream. A maintenance program will be provided to ensure continuity of this procedure.

Contingency Plan to Mitigate an Oil Spill

The use of machinery, as we construct a forest access road, presents an exposure to a potential oil spill (diesel fuel). The exposure consists of various combinations of the following mobile machines:

Backhoe

Air-track drills complete with air compressor

Fuel tanks

Tractor-dozers

Front end, rubber-tired shovel

100 HP class rubber-tired skidder.

The exposure to an oil spill could come from:

1. A fuel leak in one of the machines, or in a fuel tank.

2. A mobile machine rolls over, and ends up in a stream or water body.

For item 1, correction will be as follows:

a) Correct the leak (for a minor leak).

b) If the leak is serious, then the area around the machines should be dyked, and then the ponded fuel pumped into 45 gallon oil drums for disposal. After pumping the ponded fuel, the contaminated dyke material will be removed and be disposed of in an approved dumping area.

For item 2, correction is as follows:

a) First determine if fuel oil or hydraulic oil is leaking out of their respective tanks into the River. If so, immediately position a section of oil boom downstream of the machine.

b) Pump the tank contents into 45 gallon oil drums.

c) Remove the machine as expeditiously as possible.

d) Remove the ponded oil or fuel from the boom catchment area, and then remove the boom.

Materials and equipment required to adequately cope with the above:

Wajax fire pump and 300 feet of hose.

2 hand-operated fuel pumps.

6 45 gallon oil drums.

4 long-handled shovels.

2 pick axes.

15 yards of impervious soil (a silt or clay bearing gravel).

1 roll of oil-sorbent material.

4 bags of peat moss (oil sorbent).

1 section of oil boom.

7.0 MONITORING

A number of mitigation strategies aimed at reducing or eliminating potential negative impacts were described in the previous section. Certain of these strategies should be monitored to assess the value of the mitigation proposed. CBPPL proposes to undertake monitoring programs related to the forestry resource of the study area. These programs will include monitoring the regeneration of clearcuts, erosion in clearcuts and on road beds, culvert status, containment of stored fuels and potential archaeological sites. In other words, the Company proposes a monitoring program that is operational and forestry focused.

Ecological monitoring will not be a large part of CBPPL's program. The major ecological component, pine marten, is currently the subject of a multi-year study by individuals from Utah State University. Newfoundland Wildlife Division personnel are also participating in this study. Consequently, CBPPL believes it is unnecessary for it to engage in major ecological monitoring when university, provincial government and other agencies have a mandate and an interest in doing so. These studies include monitoring marten tracks (although it cannot be assumed that fluctuations in track numbers are caused entirely by fluctuations in population) and reproductive/recruitment rates (the assumption being that these parameters decline significantly when habitat carrying capacity is reached. The Company will co-operate (provide some logistic support for example) with these studies, and with other Government Departments which may wish to carry out their own monitoring programs.

The continuing study on pine marten is of considerable interest to CBPPL, and it has previously agreed to co-operate in this work.

A monitoring program to assess the impact of logging on steep slopes warrants consideration. CBPPL is prepared to co-operate in such a project.

8.0 DISCUSSION AND RECOMMENDATIONS

CBPPL recognizes that concerns exist over the proposed harvesting of timber at Little Grand Lake. These concerns have arisen primarily because of the steep terrain that characterizes the area and because there is a general belief that the study area may represent the last stronghold of the threatened Newfoundland pine marten. Yet, the timber resource at Little Grand Lake is essential to the continued long term operation of the Corner Brook mill; exchanging this block of timber for wood elsewhere is not an option since the deficit in wood fibre reserves predicted in the 1970's is now a reality. The question, then, is can the timber resource at Little Grand Lake be harvested without causing an unacceptable level of environmental impacts. The evidence suggests that it can.

Two of the three valued ecosystem components will be little affected by the proposed development. Field investigations carried out to evaluate the first component (historic resources) failed to discover any evidence of early or pre-historic use of the study area. Similarly, steep terrain (the second component) does not appear to be a concern: various aged cutovers on similar terrain (both inside and outside the study area) have fared well and have re-vegetated well, and the eight sites determined to be potentially sensitive to harvesting will either not be harvested (six sites) or will be harvested using all of the protective measures described in this document.

The pine marten, therefore, appears to be the only valued ecosystem component that may receive negative impact; that impact being in the form of habitat alteration. With the exception of some adjusting of standard cutting and road construction techniques to accommodate the steep terrain, the presence of the pine marten has been a major consideration in planning the harvest operation. A number of substantial travel corridors will be left in mature timber so that marten (and other wildlife) can travel from one undisturbed location to another. Buffer zones will be left along such natural travel pathways as watercourses (even where the fish resource is minimal) to accommodate the marten. And if further studies show it to be useful at Little Grand Lake, consideration will be given to creating foraging habitat for marten in larger cutovers by leaving residual conifer stands or felling such non-merchantable species as birch to make deadfalls.

These commitments for leaving areas undisturbed, plus the non-harvesting of approximately half of the forest in the study area because of terrain limitations or limited site productivity, provides a substantial area of forest for marten and other wildlife. While timber harvesting will alter the forest habitat at Little Grand Lake, there is every indication that marten (probably in reduced numbers) can continue to occupy the study area, particularly if an adequate food base is available. A depauperate food base has always been a major limiting factor for marten in Newfoundland, and ignoring this fact in the present situation would be a major mistake. The suggestion that the Wildlife Division consider introducing the red backed vole to the area is made because CBPPL believes that habitat protection alone is not the answer to the problem facing pine marten.

The question of creating a reserve for marten has been raised in the past. The Little Grand Lake area (particularly the study area) has been assumed to be the logical location for such a reserve. The focus has always been on Little Grand Lake because it is there that the first serious studies on marten were carried out, and it is there that most of the subsequent work on the species has been undertaken. But the Little Grand Lake area represents only a small portion of the high density marten habitat in this region of western Newfoundland. The many reported sightings and trappings of marten outside of the Little Grand Lake area is evidence that marten do occur throughout much of this high density habitat. Nevertheless, CBPPL has met with the Wildlife Division and there has been joint agreement on a location for a reserve within the Little Grand Lake study area. It is hoped that the Wildlife Division will monitor the status of marten within the reserve. The reserve itself could serve as the location for the previously mentioned program to breed and release marten.

Alternately, Glover Island could be considered as the site for a marten breeding program. While perhaps not an ideal site for a reserve since a natural filtering out of marten to surrounding areas is unlikely, Glover Island could play a role for marten similar to that played by Brunette Island for arctic hare. After a population buildup, marten could be live-trapped for release elsewhere.

At this point some discussion of the report by Bissonette *et al.* (1988) is in order. This two year study at Little Grand Lake was unable to provide meaningful data on the impact of timber harvesting on marten primarily because of the unfortunate mortality of a large number of radio-collared animals. Recommended strategies for timber harvesting that would minimize impact on marten were, of necessity, general in nature and not specific to the study area. The report's discussion of the GIS of resource management was regional in nature, and focused on a land base much greater than that over which CBPPL has jurisdiction. Such a program, while forward-looking, was of little value in determining the consequence of timber harvesting on marten. Consequently, for purposes of this impact assessment only the results of the field work carried out by Bissonette *et al.* (1988) were used in this EIS document.

In conclusion, it will be noted that no separate recommendations section is presented in this EIS. It is sufficient to state that the mitigation measures outlined will be undertaken and that the particular monitoring program suggested for government agencies should be carried out. Finally, CBPPL recommends that a meeting between the Company and the Department of Environment and Lands be held on a regular basis (at least once a year) to examine the project and to exchange information on mitigation and monitoring programs.

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APPENDIX I:Inventory Data for Stands Proposed for Harvesting at Little Grand Lake

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Page No.      1
11/30/89
                LITTLE GRAND LAKE STUDY AREA
             LIST OF STANDS PROPOSED FOR HARVEST

BLOCK MAP SECT STAND S  T A N D  AREA IN    SOFTWOOD
  NO.     ION   NO.  T  Y P E    HECTARES VOLUME (M3)


** HARVEST BLOCK  1
      1  83 21     8  BF 3 4 3 G      5.3    382.2773
      1  83 21     9  BF 4 5 1 G      5.0    994.4165
      1  83 21    10  BF 3 5 2 G      1.5    244.7722
      1  83 21    11  SH 4 4 2 M     24.3   1988.1677
      1  83 21    13  HS 4 5 2 G     10.9    661.7510
      1  83 21    14  BF 3 5 3 G     15.6   2198.5860
      1  83 21    15  BF 4 5 2 G     20.8   3394.1752
      1  83 21    16  BF 5 4 2 P     21.5   2401.2963
      1  83 21    18  BF 3 5 1 G     57.5  11435.7897
      1  83 21    19  BF 4 5 2 G     32.0   5221.8080
      1  83 31    42  BF 2 3 0 M     13.1      0.0000
      1  83 31    44  BF 4 5 1 G      0.2     39.7767
      1  83 31    45  BF 3 5 2 G     18.3   2986.2214
      1  83 31    46  BF 3 5 2 G     36.9   6021.3973
      1  83 31    47  BF 3 4 2 P     25.6   2859.2179
      1  83 31    48  BF 3 4 2 M      9.5   1061.0379
      1  83 31    52  BF 4 3 2 P     11.7   1079.6900
      1  83 31    53  BF 3 4 2 M     57.4   6410.9027
      1  83 31    54  BF 4 4 2 M      9.0   1005.1938
** Subtotal **
                                    376.1  50386.4776

** HARVEST BLOCK  2
      2  83 32    57  BF 2 2 0 M      8.3      0.0000
      2  83 32    58  BF 3 4 2 M     26.5   2959.7373
      2  83 32    59  BF 2 3 0 M     12.3      0.0000
      2  83 32    61  BF 3 5 1 G      9.6   1909.2797
      2  83 32    62  BF 4 4 2 M      7.7    859.9991
      2  83 32    63  BF 4 5 2 M      9.5   1550.2247
      2  83 32   121  BF 3 5 2 G     63.4  10345.7071
      2  83 32   123  BF 3 4 2 M     80.0   8935.0560
      2  83 32   130  BF 4 4 2 M      5.5    614.2851
      2  83 32   131  BF 4 4 3 P     24.9   1795.9822
      2  83 32   132  BF 3 5 2 G    200.0  32636.3000
      2  83 32   133  BF 4 5 3 M      8.5   1197.9475
      2  83 32   134  BF 4 4 3 P     18.6   1341.5771
** Subtotal **
                                    474.8  64146.0958
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LITTLE GRAND LAKE STUDY AREA
LIST OF STANDS PROPOSED FOR HARVEST

BLOCK NO.	MAP	SECTION	STAND NO.	S T	T Y	A P	N E	D	AREA IN HECTARES	SOFTWOOD VOLUME (M3)
3	83	22	4	BF	4	4	2	M	3.0	335.0646
3	83	22	5	BF	4	4	2	M	3.3	368.5711
3	83	22	8	BF	3	5	2	M	25.2	4112.1738
3	83	22	9	BF	4	4	2	M	119.0	13290.8958
3	83	22	55	BF	2	3	0	M	18.1	0.0000
3	83	22	56	BF	4	5	2	M	11.1	1811.3146
3	83	22	57	BS	4	3	2	P	2.8	312.3224
3	83	22	58	BF	4	4	2	M	43.5	4858.4367
3	83	22	59	BF	4	5	2	G	11.3	1843.9509
3	83	22	60	BF	4	4	2	M	68.7	7672.9793
3	83	22	61	BF	2	2	0	G	2.0	0.0000
3	83	22	62	BF	3	4	1	G	55.9	8600.3044
3	83	22	63	SH	4	5	2	G	5.3	635.6613
3	83	22	64	BF	4	4	3	P	5.3	382.2773
3	83	22	65	BF	4	4	3	P	15.9	1146.8320
3	83	22	66	BF	4	4	2	M	29.7	3317.1395
3	83	22	67	BF	3	5	1	G	37.2	7398.4588
3	83	22	68	BF	4	4	2	P	21.9	2445.9716
3	83	22	69	BF	4	5	2	G	21.4	3492.0841
3	83	22	70	SH	4	6	3	H	6.5	618.1500
3	83	22	74	BF	4	6	2	G	20.1	4209.4425
3	83	22	75	BF	4	4	2	M	58.4	6403.2800
3	83	22	76	SH	4	5	2	M	11.1	1331.2907
3	83	22	77	BF	4	3	2	P	13.8	1273.4806
3	83	22	78	BF	4	4	2	M	9.6	1072.2067
3	83	22	79	BF	4	4	2	M	13.8	1541.2972
** Subtotal **										
									633.9	78473.5859
** HARVEST BLOCK 6										
6	83	22	43	BF	4		2	M	12.0	1340.2584
6	83	22	45	BF	4		2	M	7.5	1223.8612
6	83	22	46	BF	2		0	M	7.3	0.0000
6	83	22	89	BF	4		2	M	11.3	1262.0767
6	83	22	90	BF	4		2	M	7.3	815.3239
6	83	22	92	BF	3		2	M	5.0	461.4060
6	83	22	94	BS	3		2	M	15.9	1450.5347
6	83	22	95	BF	3		2	M	6.0	553.6872
6	83	22	96	BF	3		2	M	22.9	2557.6598
6	83	22	97	BF	2		0	M	10.3	0.0000
6	83	22	98	BF	5		3	P	23.9	1723.8544
6	83	22	99	BS	3		2	M	21.9	2442.8070
6	83	22	101	BF	4		2	M	22.6	2524.1533
6	83	22	102	BF	4		2	M	9.6	1072.2067

LITTLE GRAND LAKE STUDY AREA
LIST OF STANDS PROPOSED FOR HARVEST

BLOCK NO.	MAP	SECT ION	STAND NO.	S T	T Y	A P	N E	D	AREA IN HECTARES	SOFTWOOD VOLUME (M3)
6	83	22	103	BF	2		0	M	4.3	0.0000
6	83	22	104	BF	2		0	M	8.6	0.0000
6	83	22	105	BF	4		2	M	4.0	652.7260
6	83	22	106	BF	4		2	M	13.8	1541.2972
6	83	22	107	BF	4		2	M	5.8	647.7916
6	83	22	108	BF	4		2	P	17.9	1999.2188
6	83	22	109	BS	4		2	P	6.8	758.4972
6	83	22	110	SH	4		2	M	26.4	3166.3130
6	83	22	111	BF	4		2	M	15.6	2545.6314
6	83	22	22	BF	4	5	3	M	0.3	42.2805
6	83	22	23	BF	4	5	2	M	10.1	1648.1331
6	83	22	24	BF	2	2	0	M	13.3	0.0000
6	83	22	25	BF	4	4	2	M	21.9	2445.9716
6	83	22	26	BF	4	4	2	M	27.2	3037.9190
6	83	22	27	BF	2	2	0	M	6.0	0.0000
6	83	22	28	BF	2	2	0	M	4.0	0.0000
6	83	22	29	BF	2	2	0	M	1.0	0.0000
6	83	22	30	BF	2	2	0	M	6.3	0.0000
6	83	22	31	BF	2	2	0	M	2.0	0.0000
6	83	22	32	BF	2	2	0	M	6.3	0.0000
6	83	22	33	BF	3	4	2	M	83.5	9325.9647
6	83	22	34	BF	4	4	2	M	32.0	3574.0224
6	83	22	35	BF	2	2	0	M	3.8	0.0000
6	83	22	36	BF	4	4	2	M	1.8	201.0388
6	83	22	37	BF	2	3	0	M	45.0	0.0000
6	83	22	38	BF	3	4	2	M	39.8	4445.1904
6	83	22	41	BF	4	5	1	G	24.9	4952.1942
6	83	22	42	BF	2	3	0	M	12.6	0.0000
6	83	22	44	BF	4	4	2	M	62.9	7025.1878
6	83	22	47	BF	3	4	2	M	67.4	7527.7847
6	83	22	48	BF	2	2	0	M	3.3	0.0000
6	83	22	51	BF	2	3	0	M	7.3	0.0000
6	83	22	52	BF	4	5	2	G	27.4	4471.1731
6	83	22	53	BF	3	4	1	G	47.6	7323.3362
6	83	32	101	BF	4	4	2	M	117.8	13156.8700
6	83	32	103	BF	4	5	3	M	5.5	775.1425
6	83	32	107	BF	3	5	2	G	56.7	9252.3910
6	83	32	144	BF	4	4	2	M	5.7	636.6227
6	83	32	145	BF	2	2	0	M	7.6	0.0000
6	83	32	146	BF	4	5	2	M	1.9	310.0448
6	83	32	147	BF	2	2	0	M	4.0	0.0000
6	83	32	148	BF	3	4	1	M	4.3	661.5619
6	83	32	149	BF	4	5	3	M	42.9	6046.1115

LITTLE GRAND LAKE STUDY AREA
LIST OF STANDS PROPOSED FOR HARVEST

BLOCK NO.	MAP	SECTION	STAND NO.	S T	T Y	A P	N E	D	AREA IN HECTARES	SOFTWOOD VOLUME (M3)
6	83	32	150	BF	2	2	0	M	22.8	0.0000
6	83	32	151	BF	2	2	0	M	6.1	0.0000
6	83	32	152	BF	2	2	0	M	3.2	0.0000
6	83	32	153	BF	4	5	2	M	22.1	3606.3111
6	83	32	154	BF	2	2	0	M	4.7	0.0000
6	83	32	155	BF	2	2	0	M	1.9	0.0000
6	83	32	156	BF	4	4	2	M	5.9	658.9604
6	83	32	157	BF	4	4	2	M	23.2	2591.1662
6	83	32	158	BF	3	4	1	M	9.9	1523.1308
6	83	32	159	BF	4	5	2	M	5.1	832.2256
6	83	32	160	BF	3	5	2	G	35.8	5841.8977
6	83	32	161	BF	3	4	2	M	13.2	1474.2842
6	83	32	162	BF	4	3	2	P	2.9	267.6155
6	83	32	163	BS	4	4	2	M	7.1	647.7231
6	83	22	49	BF	4	4	2	P	10.1	1128.0508
6	83	22	50	BF	4	3	2	P	10.6	978.1807
6	83	22	54	BF	4	4	2	M	3.3	368.5711
6	83	22	71	SH	4	5	3	M	7.3	838.7963
6	83	22	72	BF	4	4	2	M	9.8	1094.5444
6	83	22	73	BF	4	4	3	P	5.5	396.7029
6	83	22	80	BF	4	4	2	P	5.3	591.9475
6	83	22	81	BF	4	4	2	M	0.8	89.3506
6	83	22	82	BF	4	4	2	P	9.6	1072.2067
6	83	22	83	BF	4	4	2	M	27.2	3037.9190
6	83	22	84	BF	4	5	2	M	8.3	1354.4064
6	83	22	85	BF	4	4	2	M	4.0	446.7528
6	83	22	86	BF	4	3	2	M	6.0	553.6872
6	83	22	87	BF	4	5	2	M	6.3	1028.0434
6	83	22	88	BF	4	4	2	M	5.3	591.9475
6	83	22	91	BF	2	2	0	M	6.0	0.0000
6	83	22	93	BF	2	2	0	M	8.8	0.0000
6	83	22	809	BF	4	4	2	M	100.9	11269.3349
6	83	22	843	BF	4	4	2	M	35.5	4267.2278
6	83	22	875	BF	4	4	2	M	42.3	4724.5909
6	83	22	895	BF	3	3	2	M	10.1	932.7273
6	83	23	1	BF	3	4	3	M	0.3	21.6383
6	83	23	2	BF	2	3	0	M	5.0	0.0000
6	83	23	3	BF	3	4	2	M	1.5	167.5323
6	83	23	4	BF	4	4	2	M	8.5	949.3497
6	83	23	5	BF	4	4	2	M	14.3	1597.1413
6	83	23	6	BF	4	4	2	M	8.0	893.5056
6	83	23	7	BF	2	3	0	M	4.3	0.0000
6	83	23	8	BF	4	4	2	M	4.0	446.7528

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             LITTLE GRAND LAKE STUDY AREA
         LIST OF STANDS PROPOSED FOR HARVEST

BLOCK MAP SECT STAND S  T A N D  AREA IN    SOFTWOOD
  NO.     ION   NO.  T  Y P E   HECTARES VOLUME (M3)


    6  83 23      9  BF 4 4 2 M       8.5    949.3497
    6  83 23     10  BS 4 3 2 P      32.3   3602.8615
    6  83 23     11  BF 2 2 0 P       1.3      0.0000
    6  83 23     12  SH 4 5 2 M       4.3    515.7252
    6  83 23     13  BF 3 4 2 M       5.0    558.4410
    6  83 23     14  BF 2 3 0 M       1.3      0.0000
    6  83 23     15  BF 4 5 2 M      14.5   2366.1317
** Subtotal **
                                   1690.8 179874.9773

** HARVEST BLOCK  7
    7  83  5     97  BF 7 4 2 M     113.2  13607.0475
    7  83 32     65  BF 4 5 2 M     108.6  17721.5109
    7  83 32     68  BF 4 4 3 P       4.4    317.3623
    7  83 32     69  BF 4 4 2 M      40.8   4556.8786
    7  83 32    108  BF 2 3 0 M      19.9      0.0000
    7  83 32    109  BF 3 4 2 M      11.4   1273.2455
    7  83 32    111  BF 5 4 2 M      13.4   1496.6219
    7  83 32    112  BF 2 3 0 M      21.2      0.0000
    7  83 32    113  BF 3 4 2 M       4.1    457.9216
    7  83 32    114  BF 3 4 3 M      42.5   3065.4315
    7  83 32    115  BF 3 4 2 M      32.7   3652.2041
    7  83 32    116  BF 3 4 2 M      21.8   2434.8028
    7  83 32    117  BF 3 3 2 M       6.6    609.0559
    7  83 32    118  BF 3 4 2 M      12.2   1362.5960
    7  83 32    119  BF 4 3 2 P      41.1   3792.7573
    7  83 32    140  BF 3 5 2 G       7.2   1174.9068
** Subtotal **
                                    501.1  55522.3427

** HARVEST BLOCK  8
    8  83 32     38  BF 3 4 1 M      16.0   2461.6256
    8  83 32     39  BF 4 4 3 M       7.3    526.5329
    8  83 32     40  BF 3 4 2 M      49.0   5472.7218
    8  83 32     42  BF 3 5 2 G      11.2   1827.6328
    8  83 32     43  BF 4 4 2 M      18.2   2032.7252
    8  83 32     44  BF 3 5 1 G      10.0   1988.8330
    8  83 32     45  HS 4 5 2 G      20.0   1214.2220
    8  83 32     73  BF 3 5 2 G     100.0  16318.1500
    8  83 32     74  BF 2 2 0 M       2.3      0.0000
    8  83 32     75  BF 4 4 2 M      29.1   3250.1266
    8  83 32     77  BF 3 5 2 M      19.7   3214.6755
    8  83 32     78  BF 2 3 0 M       7.6      0.0000
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LITTLE GRAND LAKE STUDY AREA
LIST OF STANDS PROPOSED FOR HARVEST

BLOCK NO.	MAP	SECTION	STAND NO.	S T	T Y	A P	N E	D	AREA IN HECTARES	SOFTWOOD VOLUME (M3)
8	83	32	79	BF	2	3	0	M	7.5	0.0000
8	83	32	80	BF	3	4	1	M	50.5	7769.5058
8	83	32	81	BF	3	5	1	G	19.9	3957.7777
8	83	32	82	BF	4	5	2	G	14.5	2366.1317
8	83	32	83	BF	3	4	1	G	24.3	3738.5939
8	83	32	84	BF	4	5	2	M	31.6	5156.5354
8	83	32	85	BF	4	4	2	M	30.4	3395.3213
8	83	32	86	BF	3	4	2	M	9.4	1049.8691
8	83	32	91	BF	4	5	2	M	9.9	1615.4968
8	83	32	92	BF	4	4	3	P	13.2	952.0870
8	83	32	98	BF	4	5	2	M	120.0	19581.7800
8	83	32	104	BF	3	5	1	G	61.5	12231.3229
8	83	33	9	BF	3	4	2	M	3.0	335.0646
8	83	33	10	BF	3	4	2	M	3.5	390.9087
8	83	33	12	BF	3	4	2	M	3.3	368.5711
8	83	33	15	BF	4	5	2	M	10.9	1778.6783
8	83	33	50	BF	3	4	2	M	6.1	681.2980
8	83	33	51	BF	4	4	2	M	14.2	1585.9724
8	83	33	52	BF	3	4	1	M	6.1	938.4948
** Subtotal **										
									730.2	106200.6549
** HARVEST BLOCK 9										
9	83	32	164	BF	3	5	2	M	6.5	1060.6797
9	83	32	165	BF	5	4	2	P	1.3	145.1947
9	83	32	166	BF	3	4	1	G	7.3	1123.1167
9	83	32	167	BS	4	4	2	P	9.8	894.0403
9	83	32	168	BF	4	5	3	M	8.8	1240.2280
9	83	32	169	BF	3	4	1	G	26.3	4046.2971
9	83	32	170	BF	3	4	3	M	1.5	108.1917
9	83	33	18	BF	4	4	2	M	2.0	223.3764
9	83	33	19	BF	5	4	2	P	10.4	1161.5573
9	83	33	20	BF	5	5	2	M	5.1	832.2256
9	83	33	21	BF	4	5	3	M	0.8	112.7480
9	83	33	22	BF	3	4	1	G	34.9	5369.4208
9	83	33	23	BF	3	4	3	M	3.5	252.4473
9	83	33	70	BF	3	5	2	M	13.4	2186.6321
9	83	33	72	BF	5	5	2	M	30.4	4960.7176
9	83	33	73	BF	2	3	0	M	4.0	0.0000
9	83	33	74	BF	3	4	1	G	23.8	3661.6681
** Subtotal **										
									189.8	27378.5414

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                LITTLE GRAND LAKE STUDY AREA
            LIST OF STANDS PROPOSED FOR HARVEST

BLOCK MAP SECT STAND S  T A N D  AREA IN    SOFTWOOD
 NO.      ION   NO.  T  Y P E    HECTARES VOLUME (M3)


** HARVEST BLOCK 10
    10  83 33    53  BF 4 5 2 M      47.8   7800.0757
    10  83 33    54  BS 4 4 2 M      23.5   2143.8721
    10  83 33    55  BF 4 4 2 M      17.2   1921.0370
    10  83 33    56  BF 4 4 2 M       8.6    960.5185
    10  83 33    58  BS 4 3 2 P       6.1    680.4166
    10  83 33    59  BF 4 4 2 M      12.9   1440.7778
** Subtotal **
                                    116.1  14946.6977

** HARVEST BLOCK 11
    11  83 33     5  BF 3 5 1 G       5.0    994.4165
    11  83 33     6  BF 4 4 2 M       8.0    893.5056
    11  83 33    25  BF 4 5 2 G      23.8   3883.7197
    11  83 33    26  BF 4 4 2 M       1.8    201.0388
    11  83 33    27  BF 3 5 1 G      29.1   5787.5040
    11  83 33    28  BF 4 4 1 M      22.5   3461.6610
    11  83 33    30  BF 3 5 1 G       3.0    596.6499
    11  83 33    31  BS 4 4 2 M      14.2   1295.4461
    11  83 33    32  BF 4 4 2 M      18.0   2010.3876
    11  83 33    33  BS 4 4 2 M       4.3    392.2830
    11  83 33    34  BF 5 5 2 M      17.5   2855.6762
    11  83 33    42  BS 4 4 2 P      10.6    967.0232
    11  83 33    43  BF 4 5 2 M      20.7   3377.8570
    11  83 33    45  BF 4 5 2 M       6.6   1076.9979
    11  83 33    46  BF 4 5 2 M       4.3    701.6804
    11  83 33    48  BF 4 4 2 M      15.9   1775.8424
    11  83 33    49  BF 4 4 2 M      20.0   2233.7640
    11  83 43    80  BF 4 5 2 M       0.5     81.5907
    11  83 43    96  BF 4 4 3 P      11.1    800.6186
    11  83 43    97  BF 4 4 2 M      23.8   2658.1792
    11  83 43   105  BF 3 5 1 G      20.3   4037.3310
    11  83 43   106  BF 4 4 2 M      57.7   6444.4091
    11  83 43   107  BF 3 5 1 M       4.5    894.9748
    11  83 43   108  SH 4 5 2 M       7.9    947.4952
    11  83 43   109  BS 4 4 2 M       7.5    684.2145
    11  83 43   110  BF 4 5 2 M      14.1   2300.8591
    11  83 43   112  BF 3 4 1 G       5.9    907.7244
    11  83 43   113  BF 4 4 2 M      28.9   3227.7890
    11  83 43   114  SH 4 5 2 M      44.8   5373.1373
    11  83 43   116  BF 4 4 2 M      50.5   5640.2541
    11  83 43   120  BS 4 3 2 P       8.7    970.4302
    11  83 43   123  BS 4 4 2 P       9.3    848.4260
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LITTLE GRAND LAKE STUDY AREA
LIST OF STANDS PROPOSED FOR HARVEST

BLOCK NO.	MAP	SECTION	STAND NO.	S T	T Y	A P	N E	D	AREA IN HECTARES	SOFTWOOD VOLUME (M3)
11	83	43	124	BF	4	5	2	M	12.6	2056.0869
11	83	43	125	BF	4	4	2	M	54.3	6064.6693
11	83	43	126	BF	4	4	2	M	2.2	245.7140
11	83	43	127	BF	4	4	2	M	14.7	1641.8165
11	83	43	129	BF	4	4	2	M	5.6	625.4539
11	83	43	130	BF	4	4	2	M	24.1	2691.6856
11	83	43	131	BF	4	4	2	M	5.2	580.7786
11	83	43	132	BF	4	4	2	M	12.7	1418.4401
11	83	43	133	BF	3	4	1	M	17.6	2707.7882
11	83	43	134	BF	4	4	2	M	40.0	4467.5280
11	83	43	139	BF	3	5	1	G	30.1	5986.3873
11	83	43	140	BF	4	4	1	M	7.1	1092.3464
11	83	43	141	BS	4	4	2	M	2.9	264.5629
11	83	43	144	BF	3	3	2	M	20.4	1882.5365
11	83	43	145	BF	4	4	2	M	15.7	1753.5047
11	83	43	146	BF	4	4	2	M	94.2	10521.0284
11	83	43	149	BS	4	4	2	P	3.0	273.6858
11	83	43	150	BF	4	4	2	M	50.6	5651.4229
** Subtotal **										
									933.8	118248.3225
** HARVEST BLOCK 12										
12	71	13	98	BF	4	5	2	G	11.8	1925.5417
12	71	13	99	SH	5	5	2	M	27.3	3274.2555
12	71	13	100	BF	4	5	2	G	84.0	13707.2460
12	71	13	102	BF	4	4	3	M	2.3	165.8939
12	71	13	103	BF	4	5	1	G	62.9	12509.7596
12	71	13	104	BF	2	2	0	M	6.5	0.0000
12	71	13	105	BF	2	3	0	M	6.6	0.0000
12	71	13	106	BF	4	4	2	M	20.9	2334.2834
12	71	13	107	BF	2	3	0	M	6.2	0.0000
12	71	14	47	BS	5	4	3	P	12.1	1031.0204
12	71	14	48	BF	4	4	2	M	4.8	536.1034
12	71	14	49	BF	2	3	0	M	12.4	0.0000
12	71	14	50	BF	5	5	2	M	51.5	8403.8472
12	71	14	51	BF	2	3	0	M	15.1	0.0000
12	71	14	52	SH	5	5	2	M	2.8	335.8211
12	71	14	53	BF	4	4	3	M	14.4	1038.6403
12	71	14	54	SH	4	4	3	P	4.3	371.6275
12	71	14	56	BF	2	3	0	M	40.6	0.0000
12	71	14	57	SH	4	4	1	G	23.2	2825.1800
12	71	14	58	BF	2	3	0	M	8.1	0.0000
12	71	14	59	BF	4	5	2	G	73.9	12059.1128

LITTLE GRAND LAKE STUDY AREA
LIST OF STANDS PROPOSED FOR HARVEST

BLOCK NO.	MAP	SECTION	STAND NO.	S T	T Y	A P	N E	D	AREA IN HECTARES	SOFTWOOD VOLUME (M3)
12	71	14	60	BF	4	4	1	G	15.9	2446.2404
12	71	14	61	BF	5	5	2	M	12.4	2023.4506
12	71	14	62	BF	2	3	0	M	13.9	0.0000
12	71	14	63	BF	4	5	2	G	13.4	2186.6321
12	71	14	64	BF	2	3	0	M	15.1	0.0000
12	71	14	65	BF	4	4	2	M	1.3	145.1947
12	71	14	66	BF	4	4	3	P	1.5	108.1917
12	71	14	67	BF	3	4	2	M	18.2	2032.7252
12	71	14	68	BF	2	3	0	M	11.1	0.0000
12	71	14	69	BS	4	4	3	M	3.0	255.6249
12	71	14	70	BS	4	4	3	M	4.3	366.3957
12	71	14	71	BF	4	4	3	M	36.3	2618.2391
12	71	14	72	BF	4	4	2	M	18.4	2055.0629
12	71	14	73	SH	4	4	2	M	15.6	1276.3546
12	71	14	74	BF	5	5	2	M	40.6	6625.1689
12	71	14	75	BF	2	3	0	M	6.3	0.0000
12	71	14	76	BF	4	4	2	M	97.1	10844.9242
12	71	14	77	BF	5	5	2	M	64.6	10541.5249
12	71	14	79	WB	4	5	3	M	7.8	141.4725
12	71	14	80	BF	2	2	0	M	6.3	0.0000
12	71	14	81	BF	4	4	3	M	15.4	1110.7681
12	83	43	73	BF	4	5	2	G	23.3	3802.1289
12	83	44	1	BF	4	4	2	M	2.2	245.7140
12	83	44	2	BF	2	3	0	M	5.3	0.0000
12	83	44	3	BF	4	4	3	P	13.8	995.3636
12	83	44	4	BF	4	4	2	M	0.6	67.0129
12	83	44	5	BS	4	3	3	P	4.6	207.4025
12	83	44	7	BS	4	4	3	M	81.8	6970.0389
12	83	44	8	BF	4	4	3	M	30.4	2192.6851
12	83	44	9	BF	4	4	2	M	35.0	3909.0870
12	83	44	10	BF	4	4	3	M	8.0	577.0224
12	83	44	11	BF	4	4	2	M	5.0	558.4410
** Subtotal **										
									1120.2	124821.1996
** HARVEST BLOCK 13										
13	71	14	13	BF	1	1	0	P	194.0	0.0000
13	71	14	14	BF	5	5	2	G	54.0	8811.8010
13	71	14	15	BF	5	4	3	P	11.6	836.6825
13	71	14	16	BF	5	4	2	P	6.6	737.1421
13	71	14	17	BF	2	3	0	M	31.3	0.0000
13	71	14	18	BF	3	4	2	M	6.6	737.1421
13	71	14	19	BF	1	1	0	G	112.8	0.0000

LITTLE GRAND LAKE STUDY AREA
LIST OF STANDS PROPOSED FOR HARVEST

BLOCK NO.	MAP	SECTION	STAND NO.	S T	T Y	A P	N E	D	AREA IN HECTARES	SOFTWOOD VOLUME (M3)
13	71	14	20	BF	3	4	2	M	4.5	502.5969
13	71	14	21	BF	3	4	1	M	6.6	1015.4206
13	71	14	22	BF	5	4	2	M	31.8	3551.6848
13	71	14	23	SH	4	5	2	G	23.0	2758.5303
13	71	14	24	BF	5	4	2	P	3.8	424.4152
13	71	14	25	BF	3	4	1	M	11.4	1753.9082
13	71	14	26	BS	5	4	2	P	16.1	1468.7805
13	71	14	27	BF	5	4	2	P	10.1	1128.0508
13	71	14	28	SH	5	5	2	M	20.2	2422.7092
13	71	14	29	BS	5	4	3	P	5.8	494.2081
13	71	14	30	BF	5	4	2	P	32.0	3574.0224
13	71	14	31	SH	3	4	1	M	11.6	1412.5900
13	71	14	32	BF	2	3	0	M	5.0	0.0000
13	71	14	33	BF	5	4	2	P	21.4	2390.1275
13	71	14	34	BF	5	4	3	P	6.6	476.0435
13	71	14	35	BF	2	3	0	M	25.2	0.0000
13	71	14	36	BF	5	4	3	P	25.2	1817.6206
13	71	14	37	BF	5	4	3	M	6.6	476.0435
13	71	14	38	BF	5	4	2	M	8.1	904.6744
13	71	14	42	SH	5	5	2	G	43.4	5205.2267
13	71	24	122	BS	3	3	2	M	93.9	10473.9534
13	71	24	125	BS	3	3	2	M	4.6	513.1010
13	71	24	126	BF	1	1	0	M	11.9	0.0000
13	71	24	127	BF	1	1	0	G	18.2	0.0000
13	71	24	128	BS	2	2	0	M	19.4	0.0000
13	71	24	129	BF	1	1	0	M	3.4	0.0000
13	71	24	130	BS	1	1	0	M	17.7	0.0000
13	71	24	131	SH	5	4	2	M	19.0	1554.5344
13	71	24	132	BF	1	1	0	M	13.8	0.0000
13	71	24	133	BS	5	3	2	P	4.5	501.9466
13	71	24	134	BS	5	3	2	P	14.8	1650.8468
13	71	24	135	BS	2	2	0	M	11.5	0.0000
13	71	24	136	BF	1	1	0	G	431.5	0.0000
13	71	24	137	BF	1	1	0	G	180.6	0.0000
13	71	24	138	BF	5	5	2	G	0.5	81.5907
13	71	24	139	SH	5	5	2	M	7.0	839.5527
13	71	24	140	BS	5	5	3	M	61.0	7273.2313
13	71	24	141	BS	5	4	2	P	4.6	419.6516
13	71	24	142	BF	5	4	2	P	2.1	234.5452
13	71	24	143	BS	5	4	2	P	55.2	5035.8187
13	72	11	1	BS	5	4	2	P	7.3	665.9688
13	72	11	2	BF	5	4	2	M	10.5	1172.7261
13	72	11	3	BS	5	4	2	P	2.8	255.4401

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             LITTLE GRAND LAKE STUDY AREA
         LIST OF STANDS PROPOSED FOR HARVEST

BLOCK MAP SECT STAND S  T A N D  AREA IN     SOFTWOOD
  NO.     ION   NO.  T  Y P E   HECTARES VOLUME (M3)


    13  72 11     8  BS 5 4 3 P     12.3   1048.0621
    13  72 11     9  BF 5 4 2 P      7.3    815.3239
    13  72 21    60  BF 1 1 0 M    183.2      0.0000
    13  72 21    61  BF 1 1 0 G      6.9      0.0000
    13  72 21    62  SH 5 4 2 M     12.0    981.8112
    13  72 21    63  BF 5 4 2 M     85.1   9504.6658
    13  72 21    64  BF 5 4 2 P     46.8   5227.0078
    13  72 21    65  BS 5 3 2 P      7.7    858.8865
    13  72 21    66  BF 5 4 2 M      1.8    201.0388
    13  72 21    70  BS 5 3 2 P     11.2   1249.2894
    13  72 21    71  BF 3 3 2 P      5.1    470.6341
    13  72 21    72  BS 5 3 2 P      7.4    825.4234
    13  72 21    73  BF 5 4 2 P     44.7   4992.4625
    13  72 21    74  SH 5 4 2 M      6.1    499.0874
    13  72 21    75  BF 5 4 2 P     28.6   3194.2825
    13  72 21    76  BF 5 4 2 P      8.4    938.1809
    13  72 21    77  BS 5 4 2 P      5.9    538.2487
** Subtotal **
                                2211.6 104916.7333

** HARVEST BLOCK 14
    14  83  4    29  SH 5 6 2 G     13.0   2499.6829
    14  83  4    31  BF 5 4 1 M      9.5   1415.4800
    14  83  4    32  BF 5 5 1 G     28.3   6186.1536
    14  83  4    33  BF 5 4 2 M     20.6   2476.1942
    14  83  4    34  SH 5 5 2 G      6.5    864.7652
    14  83  4    35  HS 5 5 2 G      5.3    442.0279
    14  83  4    36  BF 5 5 1 G     36.6   8000.4672
    14  83  4    37  BF 7 4 3 P      9.8    843.1812
    14  83  4    38  BF 5 6 3 H      7.8   1361.3597
    14  83  4    39  BF 5 5 3 G     11.5   1365.0822
    14  83  4    40  BF 7 5 1 G     17.0   3716.0640
    14  83  4    41  BF 5 5 2 G     21.6   3669.0818
    14  83  4    42  SH 5 7 2 H     10.3   2799.7975
    14  83  4    43  BF 7 3 1 G      3.5    342.3000
    14  83  4    48  BF 5 4 2 P      3.2    384.6515
    14  83  4    49  BF 5 5 2 G      3.0    509.5947
    14  83  4    50  BF 5 5 2 G     28.3   4807.1767
    14  83  4    52  BF 5 5 2 M     35.8   6081.1634
    14  83  4    53  BF 5 4 2 M     26.1   3137.3140
    14  83  4    68  BF 7 5 2 M     12.0   2038.3788
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                LITTLE GRAND LAKE STUDY AREA
           LIST OF STANDS PROPOSED FOR HARVEST

BLOCK MAP SECT STAND S  T A N D  AREA IN    SOFTWOOD
  NO.     ION   NO.  T  Y P E   HECTARES VOLUME (M3)


** Subtotal **
                                   309.7  52939.9165

** HARVEST BLOCK 15
    15  83   4    70  BF 5 4 2 M    16.8   2019.4205
    15  83   4    71  BS 5 4 2 P     6.8    725.0670
    15  83   4    72  BF 5 6 2 G    40.0  10033.0400
    15  83   4    74  BF 5 4 2 M     4.0    480.8144
    15  83   4   155  BF 5 4 2 M     5.8    697.1809
    15  83   4   156  BF 5 4 2 M     3.2    384.6515
** Subtotal **
                                    76.6  14340.1743

** HARVEST BLOCK 16
    16  83   4   148  BF 5 4 2 M    57.9   6959.7884
    16  83   4   149  BF 5 4 2 P    16.8   2019.4205
    16  83   4   150  BF 5 4 2 P     6.0    721.2216
    16  83   4   151  BF 5 4 2 M    21.0   2524.2756
    16  83   4   152  BS 5 4 2 M     3.0    319.8825
    16  83   4   153  BF 7 3 1 P     3.0    293.4000
    16  83   4   154  BS 5 4 2 P    12.0   1279.5300
    16  83   5    14  BF 5 4 2 M    19.8   2380.0313
    16  83   5    16  BF 5 4 2 M     2.0    240.4072
    16  83   5    17  BS 5 4 2 M    12.8   1364.8320
    16  83   5    19  BS 5 4 2 M    12.0   1279.5300
** Subtotal **
                                   166.3  19382.3191

** HARVEST BLOCK 17
    17  83   4   157  BS 5 4 2 P    13.5   1439.4712
    17  83   4   158  BF 5 4 2 M    11.5   1382.3414
    17  83   4   159  BS 5 4 2 M     0.5     53.3137
    17  83   4   160  BF 5 5 2 M     6.8   1155.0813
    17  83   5    21  BS 5 4 2 M    15.8   1684.7145
    17  83   5    22  BF 5 4 2 M   120.7  20759.1617
    17  83   5    23  BF 5 5 2 M    69.3  11771.6376
    17  83   5    24  BF 5 4 2 M     0.5     60.1018
    17  83   5    28  BF 5 4 2 M    52.3   6286.6483
** Subtotal **
                                   290.9  44592.4715

*** Total ***
                                  9821.9 1056170.510
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